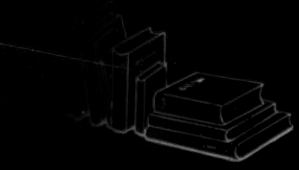
ABSTRACTS OF NORTH AMERICAN GEOLOGY



SERIALS
APR 17 1969
MICHIGAN STATE UNIVERSITY
LIBRARIES
SCIENCE
ONLY
REFERENCE
QE
71
.A2
DO NOT CIRCULATE

MARCH 1969

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ABSTRACTS OF NORTH AMERICAN GEOLOGY

MARCH 1969

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ABSTRACTS OF NORTH AMERICAN GEOLOGY

March 1969

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1969

UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Price 75 cents (single copy). Subscription price: $9.00 a year (12 monthly issues); $2.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (October 10, 1968).

(exp. 12/71)

ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

Abstracts of North American Geology and the Bibliography are prepared by use of computer techniques. Each abstract, along with its indexing, is placed on magnetic tape and entered into a permanent data bank. The material prepared each month is published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242.

The abstracts in this issue were prepared by Harold H. Arndt, Fred Barker, Arthur P. Butler, Jr., Georgianna D. Conant, Howard R. Cramer, W. C. Culbertson, Katherine A. Friberg, Jacob E. Gair, Leonard M. Gard, Andrew Griscom, Bettie S. Hackman, Anna Hietanen-Makela, B. H. Kent, J. G. Johnson, Virginia M. Jussen, E. R. Landis, Benjamin F. Leonard, R. A. Loney, Elisabeth S. Loud, D. R. Mabey, C. L. McGuinness, Mildred C. Mead, E. A. Merreweather, Willis H. Nelson, Virginia S. Neuschel, Earl H. Pampeyan, Richard M. Pratt, Edward T. Ruppel, Martha S. Toulmin, Dorothy B. Vitaliano, Holly C. Wagner, Walter S. White, and Ray E. Wilcox.

ABSTRACTS

04156 **Aamot, Haldor W. C.** Instrumented probes for deep glacial investigations: U.S. Army Materiel Command Cold Regions Research and Eng. Lab. Tech. Rept. 210, 6 p., illus., 1968.

Thermal probes have been developed that can carry instrumentation packages into polar ice sheets for geophysical investigations and long-term observations by remote measurement. They are self-contained, surface-controlled devices. During development work at USA CRREL, problems with materials, fabrication, and heat transfer analysis were solved. The Philberth probe, named for its inventor, demonstrated its performance capability in Greenland. The pendulum probe was a further development with increased performance and versatility.—Author's abstract

04380 **Abbott, Maxine L.** Lycopsid stems and roots and sphenopsid fructifications and stems from the Upper Freeport coal of southeastern Ohio: Palaeontographica Americana, v. 6, no. 38, p. 5–49, illus., 1968.

The Middle Pennsylvanian Upper Freeport coal near Kimberly, Athens County, Ohio, contains a shale parting which bears an identifiable, diversified compression flora of organ genera of lycopsids and sphenopsids, here described, and ferns and pteridosperms to be reported later. Lycopsid stems and roots (fructifications reported by Abbott, 1963) comprise 16 species of *Lepidodendron, Lepidophloios, Asolanus, Sigillaria, Stigmaria*; sphenopsid fructifications and stems (leaf genera reported by Abbott, 1958) comprise 21 species of *Bowmanites, Mazostachys, Calamostachys, Palaeostachya*, and *Calamites. Sigillaria pileata, Bowmanites incurvata, Mazostachys compacta, Palaeostachya trabeculata*, and five species of *Calamostachys* are new. Occurrences of the species in other coal-basin floras are listed.—VMJ

Abel, John F., Jr. *See* Nichols, Thomas C., Jr. 04005

04436 **Adams, R. D.** The leeward reefs of St. Vincent, West Indies: Jour. Geology, v. 76, no. 5, p. 587–595, illus., 1968.

Reef-building organisms are restricted to the leeward coast, where there are broad, shallow shelves and where little inorganic sediment is being deposited. Although well-developed reef structures are few in number and comparatively small, they are distinctly zoned, have a diverse coral, sponge, and algae assemblage, and are similar in gross morphology to several other Caribbean and Bahamian reefs.—ETR

04037 **Addicott, Warren O.** Mid-Tertiary zoogeographic and paleogeographic discontinuities across the San Andreas fault, California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 144–165, illus., 1968.

Preliminary study of Oligocene and Miocene molluscan zoogeography and related marine paleogeography confirms Hill and Dibblee's (1953) initial estimates of large post-middle Tertiary lateral slip based on matching early and late Miocene shorelines on either side of the fault. The most convincing evidence is the persistent mismatch of lithofacies and paleoenvironments of thick Oligocene and Miocene sedimentary sections of the Carrizo Plain–southern Temblor Range segment of the

fault. Probable lateral correlatives of these sections are depicted by a series of paleogeographic and faunal distribution maps. Molluscan faunal patterns during Oligocene and early Miocene are suggestive of right-lateral offset of 150–200 mi. Preliminary analysis of basin form suggests slip amounting to about 200 mi since Oligocene, 170 mi since early Miocene, and 80 mi since late Miocene.—*from* Author's abstract

04349 **Agnew, Allen F.** State and federal geological surveys, their history and growth: State Geologists Jour., v. 20, no. 2, p. 32–35, 1968.

The U.S. Geological Survey originated in 1879 as a result of consolidation of four scientific surveys made during 1867–79 as part of the exploration of the western United States. The State of Massachusetts had organized a geological survey 49 years earlier, and between 1830 and 1879, 34 of the 38 States had established a state geological survey. Economic depressions and irregularities in appropriations of money by legislatures have greatly influenced the work and progress of these surveys. Many state surveys have not spent all their resources on applied or practical aspects of geology, but have made significant contributions to theoretical or basic knowledge. The expansion of the role of geology is noted in fields of mineral exploration, hydrogeology, transportation, civil engineering, military problems, pollution and waste disposal, and cultural aspects.—MCM

03971 **Aitken, M. J.; Fleming, S. J.; Doell, R. R.; Tanguy, J. C.** Thermoluminescent study of lavas from Mt. Etna and other historic flows—Preliminary results, Chap. 6.4 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 359–366, illus., table, 1968.

Thermoluminescence, like the K–Ar "clock" for millions of years, could be set at the time a lava cools, when it acquires remanent magnetism. Mineral separates studied here included plagioclase from the 1915 Mt. Lassen flow; sanidine, plagioclase and anorthoclase concentrates 0.4–0.7 m.y. old; whole rock and separates from porphyritic Mt. Etna lavas with known ages back to 2,000 years, having 30–40 percent phenocrysts of plagioclase and pyroxene plus some olivine and magnetite; and, to account for low equivalent rads, lavas without phenocrysts from the 1065 Kana-a flow, Ariz., and from seven Hawaiian flows, 1750–1907. Anomalous glow, probably produced during preparation of separates, discourages use of thermoluminescence for dating lava flows. Portions of plagioclase, lower in magnetic susceptibility than others, had greater glow, which increased with additional grinding.—GDC

04475 **Aki, K.** Seismicity and seismological method, *in* Earthquake prediction—Proceedings of a symposium, Zürich, Switzerland, 1967: Tectonophysics, v. 6, no. 1, p. 41–58, illus., 1968.

Earthquake prediction may possibly be achieved through a study of the relation between microearthquakes in the area of an anticipated large earthquake; success depends upon understanding of the earthquake source mechanism. Both ray and normal mode theory are useful in such studies but have limitations. Recent studies on the relation between micro- and large earthquakes in southern California and Japan are reviewed, and results show that even within the same tectonic area with the same regional stress conditions, the mode of seismic activity can be quite different from place to place. If techniques can be improved to obtain more precise knowledge about the physics of seismic wave sources, however, it may be possible to understand why this is true and to develop a prediction method.—VSN

04042 **Aki, Keiiti.** Source mechanism of the Parkfield earthquake [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 83, 1968.

Akimoto, Syun-ichi. *See* Kushiro, Ikuo. 04485

04445 **Alcordo, Isabelo Suelo.** The flow properties of montmorillonite, Fe-montmorillonite, Al-montmorillonite, and soil clay suspensions and their changes

with anaerobic reduction [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 445B, 1968.

04041 **Allen, Clarence R.** The tectonic environments of seismically active and inactive areas along the San Andreas fault system, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 70–80, illus., 1968.

It is suggested that the two segments of the San Andreas fault that were characterized by great earthquakes in 1857 and 1906 have generated infrequent great shocks throughout the recent geologic past, and that the present absence of creep is typical of past and future behavior between shocks. The three remaining segments, on the other hand, are sites of abundant small earthquakes and fault creep, and it is suggested that this behavior is constant and great earthquakes are unlikely. The 1857 and 1906 zones both have single simple traces, without splaying branch faults, and a marked bend in the middle; active areas show branching, splaying, and en echelon breaks. In addition to length of fault, a further critical factor determining the maximum size of an earthquake may be the simplicity of the trace. Basement rock types may also have an effect on the type of strain release.—*from* Author's summary

Allen, Eldon P. *See* Wilson, William F. 04102

04014 **Alt, David.** Pattern of post–Miocene eustatic fluctuation of sea level, *in* Tertiary sea–level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 87–94, 1968.

The Orangeburg Scarp, at 200–250 feet, is the oldest (late Miocene) and highest marine terrace on the Atlantic coast. Citronelle gravel covers anything higher or older. The next highest, the Pliocene Surry Scarp, is at 90–100 feet. Shorelines which are recognized by various authors at intermediate elevations are not prominent and do not mark prolonged stands of sea level. The late Miocene–Pliocene withdrawal appears to have been eustatic, and Antarctic glaciation appears to have been the cause. Withdrawal from the Pliocene stand began when the Northern Hemisphere became glaciated. Distinct but not prominent Pleistocene interglacial shorelines occur at 40–45 (Aftonian interglacial), and 5–10 feet (Sangamon interglacial). A prominent stand at 25–30 feet is correlated with the Yarmouth interglacial.—HRC

Ames, H. T. *See* Traverse, A. 04328

04345 **Anders, Edward.** Chemical processes in the early solar system, as inferred from meteorites: Accounts Chem. Research, v. 1, no. 10, p. 289–298, illus., 1968.

Meteorites are consistently older, radioactively, than the oldest known rocks on Earth. Clues to earliest extraterrestrial records are their chemical and isotopic composition, structure, and mineralogy. Chondrites are most primitive in composition and are little changed from the solar nebula from which planets accreted. Trace elements are similar to those found in Earth's crust; their depletion is greater in ordinary than in carbonaceous or enstatite chondrites. Of various theories to explain their fractionation, evidence favors accretion prior to the Sun's formation at 520–680°K, maintained by some force other than solar heating. The place of origin of each kind of meteorite is still a challenge, the problem of carbon condensation is not yet solved, and pertinent data is lacking for several other trace elements and metallic solubilities.—GDC

04432 **Anderson, A. T.** Oxidation of the LaBlache Lake titaniferous magnetite deposit, Quebec: Jour. Geology, v. 76, no. 5, p. 528–547, illus., tables, 1968.

Steeply dipping tabular ore bodies in anorthosite northeast of Forestville consist mainly of ulvöspinel–bearing magnetite, dark green ferroan spinel, and hematite–free granular ilmenite. Modal, chemical, and oxygen–isotopic data, as well as thermodynamic considerations, point to development of ilmenite by oxidation exsolution from titaniferous magnetite during slow magmatic cooling from about 1000°C, the temperature at which the deposit was separated from its silicate host.

The oxidizing agent is not specified. The magnetite–ilmenite geothermometer-oxygen barometer of Buddington and Lindsley (1964) yields only minimum temperatures and oxygen fugacities here. Anomalous oxygen-isotope ratios and increased ilmenite content of two ore samples are attributed to metasomatism.—BFL

Anderson, Alfred T. *See* Desborough, George A. 04124

Anderson, Don L. *See* Spetzler, Hartmut. 04486

04277 **Andrews, Henry N.; Phillips, Tom L.** *Rhacophyton* from the Upper Devonian of West Virginia: Linnean Soc. London Jour., Botany, v. 61, no. 384, p. 37–64, illus., table, 1968.

The pteridophyte *Rhacophyton ceratangium*, n.sp., is described from the Hampshire Formation near Valley Head, W. Va. The abundant specimens, mostly compressions, include stems with bipinnate vegetative fronds attached, fertile fronds, and fragments of axes with woody tissues pyritized. Sporangia with long, slender tips dehisced longitudinally and contained several hundred spores, apparently homosporous. Restoration shows an erect dichotomized stem about 50 cm high, with spirally arranged fronds. The species is synonymous with *R. incertum* (Dawson) Kräusel and Weyland, 1941, from Elkins, W. Va., but that name is misleading because Dawson's (1862) New York material is probably not *Rhacophyton*. *R. ceratangium* is closely related to the Belgian *R. zygopteroides* Leclerq. Comparisons suggest that the genus is at an evolutionary level slightly below Progymnospermopsida.—VMJ

04460 **Apmann, Robert Proctor.** The diffusion of sediment in a non-uniform flow field [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 620B, 1968.

04094 **Archambeau, Charles B.** General theory of elastodynamic source fields: Rev. Geophysics, v. 6, no. 3, p. 241–288, illus., 1968.

It is concluded that a relaxation theory will provide the flexibility required to describe characteristics of the observed radiation field and also provide estimates of rupture parameters bearing on the processes of failure and state of the material. The main result of this study is a complete development of the dynamic relaxation theory for tectonic sources, including considerations of total energy release and final equilibrium field, providing explicit expressions for the dynamic and static displacement and energy fields. The radiation field will generally have a frequency-dependent shape, dependent to first order on the ratio of rupture length to radiation wavelength. The radiation pattern and displacement, and energy spectra are computed for a simple example, and the pattern contrasted with that from a more complicated rupture geometry. Pattern shape dependence on frequency, rupture geometry and prestress is shown.—*from* Author's abstract

04074 **Armstrong, R. W.** Wedge dislocation as the elastic counterpart of a crystal deformation twin: Science, v. 162, no. 3855, p. 799–800, illus., 1968.

A crystal deformation twin may be visualized to form and grow by the movement of partial dislocatio ıs only if the twinning dislocations are especially distributed to give an invariant shear. One consequence of this requirement is that, if a critical resolved twinning stress exists in the same sense for twinning as for slip, this stress depends on the reciprocal thickness of the twin. This type of model for twinning may be developed through the use of relatively unknown disclinations, in particular, the wedge dislocation.—Author's abstract

04255 **Ash, Sidney R.** A new species of *Williamsonia* from the Upper Triassic Chinle Formation of New Mexico: Linnean Soc. London Jour., Botany, v. 61, no. 384, p. 113–120, illus., 1968.

Williamsonia nizhonia, n.sp., the first undoubted bennettitalean [cycadeoid] flower known from the Chinle Formation in southwestern U.S., is described in detail. The species is based on a single vertically compressed specimen collected from the Lower Red Member near Fort Wingate in west-central New Mexico. It is rather small, the gynoecium is about 5 mm in diameter and is surrounded by a whorl

of 10 persistent sterile bracts about 1.5 cm long. The cuticles of the bracts and the interseminal scales are 1 to 2 μ thick, and bear stomata that are only slightly sunken. Only a few hairs occur on the bracts. This species cannot be attributed with confidence to either of the two bennettitalean leaves [*Otozamites powelli* and *Nilssoniopteris* sp. A] presently known in the Chinle flora.—*from* Author's abstract

04099 **Askren, L. T., Jr.** Bryozoan paleoecology from the Tertiary of Alabama: Southeastern Geology, v. 9, no. 3, p. 157–163, illus., 1968.

In the last few decades several investigators have successfully related bryozoan colonial forms to ecologic conditions. This relationship was used in examination of bryozoa from an upper Eocene and Oligocene section from St. Stephen, Ala. Samples were processed from the Yazoo Clay, Red Bluff Clay, "Forest Hill" Sand, Marianna Limestone, Byram Formation and Chickasawhay Limestone. Simultaneous with an increase in terrigenous material in successively younger samples, especially in the Glendon Limestone Member of the Byram Formation and Chickasawhay Limestone, there was a pronounced increase in those colonial forms thought to be better adapted to more agitated, neritic conditions.—Author's abstract

Axtell, L. H. *See* Gaede, Verne F. 04418

Baadsgaard, H. *See* Chrismas, L. 04138

04288 **Backus, George; Gilbert, Freeman.** The resolving power of gross Earth data: Royal Astron. Soc. Geophys. Jour., v. 16, no. 2, p. 169–205, illus., 1968.

A gross Earth datum is a single measurable number describing some property of the whole Earth, such as mass, moment of inertia, or the frequency of oscillation of some identified elastic-gravitational normal mode. We show how to determine whether a given finite set of gross Earth data can be used to specify an Earth structure uniquely except for fine-scale detail; and how to determine the shortest length scale which the given data can resolve at any particular depth. We apply the general theory to the linear problem of finding the depth-variation of a frequency-independent local Q from the observed quality factors Q of a finite number of normal modes. We also apply the theory to the non-linear problem of finding density vs. depth from the total mass, moment, and normal-mode frequencies, in case the compressional and shear velocities are known.—Authors' abstract

Bair, F. L. *See* Bradford, G. R. 04472

Baker, Seymour R. *See* Blee, John J. 04400

04524 **Balsiger, H.; Geiss, J.; Groegler, N.; Wyttenbach, A.** Distribution and isotopic abundance of lithium in stone meteorites: Earth and Planetary Sci. Letters, v. 5, no. 1, p. 17–22, illus., tables, 1968.

The abundances and isotopic composition of lithium were determined in an achondrite and in separated chondrule and matrix fractions from one chondrite of each of the classes LL3, H3, L4, and L6. No significant variations in the $^7Li/^6L$ ratios were found. The lithium abundances in bulk chondrites are between 1.45 and 2.0 ppm. The abundances in the separated chondrule fractions are not significantly different. The lithium concentration in a bulk sample of the Norton County aubrite is 0.33 ± 0.07 ppm, and in separated coarse enstatite crystals, 0.23 ± 0.04 ppm.—Authors' abstract

Balster, C. A. *See* Parsons, R. B. 04192

04016 **Bandy, Orville L.** Cycles in Neogene paleoceanography and eustatic changes, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 63–75, illus., 1968.

The sinistrally-coiled *Globigerina pachyderma* is a key to Arctic and Antarctic cold-water deposition and shows the classic Pleistocene isotherm alterations. Similar

isotherm alteration can be detected in Middle Pliocene and Later Miocene, suggesting glacial influence, though not as great as in the Pleistocene. Marine regression sedimentation should be associated with such isotherm fluctuations. In the absence of complications due to variable rates of sedimentation and tectonism, shallow water depositional sites may show an upper Miocene nonmarine phase or unconformity, a lower Pliocene marine phase, a middle Pliocene nonmarine phase or unconformity, an upper Pliocene marine phase, and a major regression at the beginning of Quaternary. A re-evaluation of Neogene marine sections is suggested. It may be possible that the transgressive facies of the Calabrian of Italy correlates with later Pliocene of California and is older than 3×10^6 years.—*from* Author's summary

04118 **Barakso, John.** Geochemical field kit for the determination of trace amounts of molybdenum [reply to 1968 discussion by Bloom of 1967 paper]: Econ. Geology, v. 63, no. 6, p. 695–696, 1968.

At sufficient temperature, potassium pyrosulfate fusion should generate enough sulfuric acid to attack molybdenite and make the field test valid for samples with this sulfide. "Nearly total" is preferred to "total" for actual amount of Mo extracted from rocks and soils (original paper, ibid., v. 62, no. 5, p. 732–736, 1967).—WSW

Barosh, Patrick J. *See* Brokaw, Arnold L. 04210

04174 **Barrett, William; Besterman, Theodore.** The divining rod—An experimental and psychological investigation: New Hyde Park, N.Y., University Books, 336 p., illus., 1968.

This factual, historical, and theoretical survey of dowsing has been revised and amplified from Barrett's original reports. The historical and geological part includes a brief historical sketch of dowsing, three famous French dowsers, and dowsing and geology. The experimental section includes accounts of 19th century and contemporary British dowsers as well as various experiments. The mechanism and rationale of dowsing are examined in the theoretical part. Appendixes contain an explanation of *Zahoris*, an account of dowsing for mineral water in the United States, and American dowsers. A bibliography and an index are included.—MCM

04404 **Bartlett, Grant A.** Mid-Tertiary stratigraphy of the continental slope off Nova Scotia: Maritime Sediments, v. 4, no. 1, p. 22–31, illus., 1968.

To date, consolidated Tertiary sediment containing planktonic Foraminifera has been sampled in depths as great as 2,200 m along the Scotian Slope. The Oligocene–Miocene section examined extends from the *Globigerina opima opima* zone to the top of the *G. mayeri* zone; benthonic assemblages have diagnostic Miocene Ostracoda. The planktonic and benthonic fauna are comparable to those from Trinidad, Venezuela and Brazil; their similarity to those in the Caribbean area suggests a warm-water connection and a warm climatic belt extending from the Caribbean to at least southern Newfoundland during mid-Tertiary time. Paleontological, sedimentological and structural evidence implies marine deposition in a large subsiding basin along the continental shelf off Nova Scotia, in which sediments are a continuation of the Gulf Coast and Atlantic Coastal Plain physiographic province.—GDC

04105 **Barton, William R.** Dimension stone: U.S. Bur. Mines Inf. Circ. 8391, 147 p., illus., 1968.

General occurrence of rock used for dimension stone is mentioned by rock type and state, and production since 1929 is listed by rock type.—APB

04388 **Batchelder, George L.; Reger, Richard D.** New evidence for a late Pleistocene or early Recent lake near Winona, Coconino County, Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 9, 1968.

04422 **Beecroft, G. W.** North, South and East areas of Rosedale oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1967, v. 53, no. 2, pt. 2, p. 49–55, illus., tables, 1968.

Rosedale field is on the Bakersfield arch, a major feature of the subsurface structure of the San Joaquin basin; the structure is a faulted, broad, gently-bowing nose that plunges westward. The Bellevue fault, north-trending, westward-dipping, and normal, bisects the field. Deepest penetration has been 10,761 feet through 450 feet of lower Miocene Vedder Formation. Producing zones are: North area, top portion of Lower Massive sand of Stevens Member of the Miocene Fruitvale shale; South area, Stevens Stringer and Main Stevens; and East area, short-lived production within the Stevens.—MCM

Behrendt, M. *See* Degens, E. T. 04440

04071 **Bell, R. T.** Preliminary notes on the Proterozoic Hurwitz Group, Tavani (55 K) and Kaminak Lake (55 L) areas, District of Keewatin: Canada Geol. Survey Paper 68-36, 17 p., illus., 1968.

Initial results of a continuing stratigraphic and sedimentological study of the Hurwitz Group and related rocks are summarized. The Group and rocks are largely confined to two down-folded and faulted belts—the Kaminak belt in Kaminak Lake map-area (55 L) and the Whiterock belt in Tavani map-area (55 K). The Hurwitz Group in these areas is divisible into seven distinct mappable units. Exposure is poor to mediocre except for the orthoquartzite units which form the 'backbone' of the Hurwitz and have been considered to be the most typical lithology. Studies have established sedimentological trends suggesting that the southwest end of the Kaminak belt and the area southwest of Kaminak Lake map-area may be favorable for exploration for uraniferous (and auriferous) placer deposits but in Tavani area conditions are not auspicious.—*from* Author's abstract

Bell, R. T. *See* Norris, A. W. 04266

04529 **Benedict, James B., Jr.** Neoglacial history of the Colorado Front Range [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 955B, 1968.

04544 **Bennett, Hugh Frederick.** An investigation into velocity anisotropy through measurements of ultrasonic wave velocities in snow and ice cores from Greenland and Antarctica [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 662B, 1968.

Berg, E. *See* Kubota, S. 04479

04506 **Berg, Robert R.; Davies, David K.** Origin of Lower Cretaceous Muddy Sandstone at Bell Creek field, Montana, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1888-1898, illus., table, 1968.

The Muddy Sandstone forms a stratigraphic trap at the Bell Creek field. The sandstone is very fine to fine grained, well-sorted, lenticular, and has an average thickness of 20 feet. Generally, the grain size increases upward. The quartz content ranges from 50 to 99 percent and averages 86 percent. The porosity and permeability of the unit are as much as 33 percent and 13,500 md., respectively. The bedding changes upward from massive to laminated and crossbedded. The sandstone is laminated and burrowed, in the basal two feet, and is apparently gradational with the underlying shale. The mineral composition, vertical textural change, bedding, and gross morphology are evidence that the Muddy Sandstone is a barrier bar. The updip permeability barrier may be the lagoonal siltstone and shale to the southeast.—EAM

04438 **Berger, Wolfgang H.** Planktonic Foraminifera—Selective solution and paleoclimatic interpretation: Deep-Sea Research, v. 15, no. 1, p. 31-43, illus., table, 1968.

Any sediment assemblage of planktonic Foraminifera contains information on amount of solution experienced, geographic origin, and range of depth habitats of constituent species. Selective solution can change the apparent latitudinal range of an assemblage and its depth habitat aspect. Corrections must be applied before drawing conclusion on the latter two ecological properties. It is then possible to

trace in the sediments movement of water bodies at different depth levels in the ocean. In the central Atlantic, the present current structure at the surface is reflected in bottom sediments with precision. The level at which the rate of solution of calcium carbonate rapidly increases apparently coincides with the top of the Antarctic Bottom Water. Older sediments suggest wider surface currents and higher solution levels in the past.—*from* Author's abstract

04267 **Bergstrom, Robert E.** Feasibility criteria for subsurface waster disposal in Illinois: Ground Water, v. 6, no. 5, p. 5–9, illus., 1968.'

Favorable geohydrologic conditions—specifically the presence of a variety of permeable formations that contain nonpotable water and are well confined from shallow to great depth—make waste disposal by wells feasible in much of the southern two-thirds of Illinois. Natural safeguards permit disposal wells to be planned with conventional engineering precautions and only a minimal program of preoperational testing. In much of the northern third of the state, the permeable rocks contain potable water to great depth, and there is moderate to high development of ground-water resources because of urban and industrial concentration. Exhaustive testing, substantial proof of acceptable site conditions, and incorporation of optimum engineering safeguards are considered necessary before the State regulatory agency can authorize installation.—*from* Author's abstract

04048 **Berry, Frederick A. F.** High fluid potentials in the California Coast Ranges and their tectonic significance [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 109, 1968.

04320 **Berry, William B. N.** Growth of a prehistoric time scale, based on organic evolution: San Francisco, Calif., W. H. Freeman and Co., 158 p., illus., 1968.

This book tells of the search that led to the development of a method for dividing prehistoric time based on the evolutionary development of organisms as revealed by the fossil record in rocks of the Earth's crust. Not all time units ever proposed are mentioned, for it is not an exhaustive catalog of units. Chapter headings are: a need for a time scale; first principles; attempts at division; Darwin's contribution—organic evolution through natural selection; a maelstrom of opinions; growth and development of the periods; Lyell's percentages; an overview of the Earth's fossil record; units with boundaries, and marker points and the correlation web. A bibliography and index are included.—MCM

04496 **Berthelsen, A.; Noe-Nygaard A.** Dokembriy Grenlandii, *in* Dokembriy Kanady, Grenlandii, Britainskikh Ostrovov, i Shpitsbergena (K. Rankama, editor): Moscow, Izdatel'stov "MIR", p. 107–235, illus., tables, 1968; originally published in English, 1965.

This is a Russian translation of the article by Asger Berthelsen and Arne Noe-Nygaard *in* The geologic systems—The Precambrian, V. 2 (Kalervo Rankama, editor): New York, London, Interscience Publishers, 1995. *See* Abstracts of North American Geology for October 1966.—VSN

Besterman, Theodore. *See* Barrett, William. 04174

04393 **Beus, Stanley S.; Rush, Richard W.; Smouse, DeForrest.** Geology of the Beaver Creek experimental drainage basin, Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 25, 1968.

04437 **Bhattacharji, Somdev.** Mechanics of flow differentiation in ultramafic and mafic sills—A reply [to discussion by D. Bridgwater of 1967 paper]: Jour. Geology, v. 76, no. 5, p. 599–600, 1968.

Bridgwater's discussion (ibid., p. 596–599) of this paper refers to another type of dike. However, the dikes of microsyenite and trachydolerite referred to by Bridgwater show a zonation that is not experimentally reproducible.—FB

Bidwell, L. E. *See* Cotter, R. D. 04378

Bidwell, L. E. *See* Maclay, R. W. 04424

Biggs, Charles A. *See* McGregor, Alexander A. 04505

Birch, Francis. *See* Roy, Robert F. 04526

03976 **Birkeland, P. W.** Correlation of Quaternary stratigraphy of the Sierra Nevada with that of the Lake Lahontan area, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 469–500, illus., tables, 1968.

Truckee River flows eastward from the California Sierra Nevada into the Lake Lahontan basin of Nevada, and deposits can be correlated between both areas. K–Ar dated volcanic flows are the oldest Quaternary rocks; paleomagnetism and topography are also used to correlate them. Two preglacial Truckee River fills are the oldest deposits. Tills of four glaciations are recognized at Truckee and outwash terrace deposits of the youngest three are well preserved. Subsequent erosion and deformation have made downstream correlation difficult. Pre–Donner Lake boulder gravel that might be the oldest outwash can be traced to Reno but not into the Lahontan basin. The next two younger outwashes are common in the river and in the Lake Lahontan basin. The youngest outwash (Tioga) is not recognized downstream from Truckee basin. Tectonic activity has deformed some of the Tahoe outwash in Truckee Meadows.—*from* Author's abstract

04530 **Bissada, Kadry Kaddis.** Cation–dipole interactions in clay organic complexes [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 655B–656B, 1968.

Bitter, Reed K. *See* Warner, M. A. 04489

Blackwell, David D. *See* Roy, Robert F. 04526

04200 **Blanchard, Frank N.** Differential thermal analysis of wavellite: Florida Acad. Sci. Quart. Jour., v. 30, no. 3, p. 161–167, illus., 1967[1968].

Changes which take place in wavellite during differential thermal analysis, and the variations in DTA patterns among six samples of wavellite from five countries are described. Between 150° and 380° there is a typical pattern for wavellite, with a strong endothermic reaction at 260° and a weak one at 320°. Two samples representing extremes of peak–height ratio, and one representing a median, were chosen for further study by X–ray, thermal, and optical techniques. These differences may be related to differences in degree and nature of crystallinity. Use of the method in detection and quantitative determination of wavellite in rocks is evaluated.—ESL

04146 **Blattert, Robert E.** The effects of peat deposits on highway design in Iowa, *in* Highway geology symposium, 17th Ann., Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 36–53, illus., table, 1968.

This report is prepared to encompass an understanding of the occurrence of peat deposits in Iowa, and the effects they have on highway design. The need for highways with Interstate standards in northern Iowa has made it necessary for engineers to locate highways over adverse soil conditions. One of the most costly, although interesting, of these conditions is that of peat. Many problems have developed, and some are discussed here.—Author's introduction

04400 **Blee, John J.; Baker, Seymour R.; Friedman, Gerald M.** Sedimentological survey of Baffin Bay: Maritime Sediments, v. 4, no. 1, p. 4–6, illus., 1968.

Bottom samples, from Baffin Bay traverses between northern Canada and Greenland, are being studied for acoustic, petrographic, mineralogical, and biological characteristics and their dependence on Arctic marine processes. Radiographs obtained by X–ray analysis of 28 unopened cores indicate a highly complex sedimentary basin with bottom currents and ice–rafting as two important

agents of transport and deposition. Material was found to be homogeneous through the core length in only 5 of 28 cores studies; in 8, fine laminations averaged 5 mm or less in thickness; in 15, thickness of interbeds ranged from 5 to 75 cm. In 6 cores from water depths of 821 to 2383 m, cross-bedding occurs in beds 2 to 15 cm thick, with forset dips of 5 to 30°, at depths of 82 to 148 cm below the water-sediment interface within cores. Degrees of pebble concentrations were variable.—GDC

04250 **Blight, G. E.** A note on field vane testing of silty soils: Canadian Geotech. Jour., v. 5, no. 3, p. 142–149, illus., 1968.

The field vane test is usually used to measure the strength of clays, but it may also be applied to measurements in silty soils. Because of the relatively high permeability of silts, drainage of the soil surrounding the vane can take place even during a fairly rapid test. A method is proposed that enables the preselection of a test duration such that the strength measured is that of the fully drained soil. The procedure has been developed by both empirical and theoretical means. Author's abstract

04461 **Bohidar, Naikananda K.** Stress distribution around a cylindrical opening under uniaxial compression and lateral confinement [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 634B, 1968.

03957 **Bonilla, Manuel G.** Evidence for right-lateral movement on the Owens Valley, California, fault zone during the earthquake of 1872, and possible subsequent fault creep [abs.], *in* Conference on geologic problems, San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 4; discussion, p. 5, 1968.

04531 **Booker, John Ratcliffe.** Geomagnetic secular variation and the kinematics of the Earth's core [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 656B, 1968.

Bostock, H. H. *See* Sanford, B. V. 04265

04069 **Bostock, H. S.** A catalogue of selected airphotographs: Canada Geol. Survey Paper 67–48, 163 p., 1968.

This catalog of selected airphotographs of geomorphologic phenomena in Canada replaces Paper 47–26 (1947); it is restricted to photographs taken from aircraft, most of which were made to facilitate topographic mapping of Canada. It does not cover the extensive collection of the Geological Survey taken by field officers. The three sections of the catalog are: a subject classification of features; a serial listing of the photographs, including a brief discussion of the feature, pertinent technical data, and the source from which the photograph can be obtained; and a finding list which ties the location of each photograph to the National Topographic System and thus provides a means of selecting photographs for specific geographic areas. The latter list should be used in conjunction with the NTS index map in pocket.—MCM

04517 **Boswell, E. H.; Cushing, E. M.; Hosman, R. L.** Quaternary aquifers in the Mississippi embayment, *with a discussion of* Quality of the water by H. G. Jeffery: U.S. Geol. Survey Prof. Paper 448–E, p. E1–E15, illus., tables, 1968.

Quaternary alluvial deposits form ground-water reservoirs of varying thicknesses in a 45,000 sq mi area of the Mississippi embayment. The Mississippi River valley and Red River aquifers are the most important sources of ground water in the area. Water is also available from alluvial deposits along tributary streams. The water is suitable for irrigation and industrial uses but is used for public supplies only when water of better quality is not available from deeper sources. Most wells are less than 150 feet deep; yields of 500 gpm are common. Water levels are generally less than 20 feet below the land surface. The amount of water stored in the alluvial deposits is about 120 trillion gallons. Withdrawals in 1965 were 1,600,000 acre feet. Water level declines of 20–30 feet are usual in areas of large withdrawal; levels in many areas recover to near normal each year. The principal source of recharge is precipitation.—*from* Authors' abstract

04545 **Bottinga, Yan.** Isotopic fractionation in the system—Calcite–graphite–carbon dioxide–methane–hydrogen–water [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 662B–663B, 1968.

04497 **Bottino, Michael L.; Fullagar, Paul D.** The effects of weathering on whole-rock Rb–Sr ages of granitic rocks: Am. Jour. Sci., v. 266, no. 8, p. 661–670, illus., tables, 1968.

Four weathered samples of the Cape Ann Granite from Massachusetts average ten percent younger than the age from the whole-rock isochron. Fourteen fresh samples from the Petersburg Granite, Virginia, do not define an isochron, but the average age of seven weathered samples is 8 to 15 percent younger than the average of the fresh samples. For Petersburg Granite, the minimum age and maximum $(Sr\text{–}87/Sr\text{–}86)_0$ ratio are 460 m.y. and 0.7245 respectively. Assuming a $(Sr\text{–}87/Sr\text{–}86)_0$ ratio of 0.705, the maximum age is 690 m.y. The Petersburg Granite is late Precambrian to early Paleozoic in age.—*from* Authors' abstract

04114 **Boucot, A. J.; Johnson, J. G.** Brachiopods of the Bois Blanc Formation in New York: U.S. Geol. Survey Prof. Paper 584–B, p. B1–B27, illus., tables, 1968.

Thin exposures of the Bois Blanc Formation in two localities in New York yielded 26 species of silicified brachiopods. Of these, *Cloudothyris postovalis* is proposed as a new genus and species. The brachiopod fauna of the Bois Blanc and Schoharie Formations of New York and their equivalents elsewhere in North America is the youngest brachiopod fauna in eastern North America that can be assigned to the Early Devonian, and is assigned to the Emsian Stage at the top of the Lower Devonian. The fauna is discussed in terms of rensselaeriid and acrospiriferid evolution, and Bois Blanc–Schoharie paleogeography in eastern North America is described in terms of quartz-rich and limestone-chert belts with the former adjacent to an eastward land area.—JGJ

04426 **Boyce, R. E.; Smith, E. L.** Geomorphology of Erben Guyot: Marine Geology, v. 6, no. 2, p. 179–183, illus., 1968.

Results are discussed of a bathymetric survey of 250 sq mi in the area of Erben Guyot, a volcanic feature 800 mi west of San Diego, Calif., adjacent to the Murray fracture zone. The guyot has an overall conical form about 2,200 fathoms high; its top is a 4×6 mi platform at depths from 300–500 fathoms. In places slopes are as great as 45° and are probably bedded lava flows and volcanic debris. Two other peaks on the flanks appear to be volcanic vents or fissures. A bathymetric chart and a profile of the guyot are included.—VSN

04232 **Boyle, R. W.; Dass, A. S.** Geochemical prospecting—Use of A horizon in soil surveys [reply to discussion by Roy and Paul, 1967, of 1967 paper by Boyle and Dass]: Econ. Geology, v. 63, no. 4, p. 423, 1968.

The likelihood that the A horizon is not universally the layer most enriched in metals makes orientation surveys on all horizons a desirable first step in geochemical surveys (original paper, ibid., v. 62, p. 274–276, 1967).—WSW

04234 **Boyle, R. W.; Lynch, J. J.** Speculations on the source of zinc, cadmium, lead, copper, and sulfur in Mississippi Valley and similar types of lead-zinc deposit: Econ. Geology, v. 63, no. 4, p. 421–422, tables, 1968.

Noteworthy trace-metal contents in the soft parts of certain marine organisms show the possible importance of such organisms as factors in the formation of ore deposits in marine sedimentary rocks. Where these soft parts decompose in a reducing environment, the metals would be preserved in the sediment, available for later epigenetic redistribution.—WSW

04261 **Bozozuk, M.** The spiral-foot settlement gauge: Canadian Geotech. Jour., v. 5, no. 2, p. 123–125, illus., 1968.

Since 1958 the Soils Mechanics Section of the Division of Building Research, National Research Council of Canada, has installed 400 spiral-ft vertical ground

movement gages to depths up to 100 feet in various parts of Canada. Difficulties from freezing, from punching into the soil, and from jamming that had occurred with other types of gages have been overcome. Cast in bronze, the spiral foot will not rust in soil and can be re-used. The complete gage can be filled with oil from the bottom up and serviced any time after installation. Materials required and installation procedure are described. Absolute vertical ground movements are measured to the nearest 0.001 ft with a precise engineer's level using a bench mark set down to bedrock as a datum reference point.—GDC

Brace, W. F. *See* Byerlee, James D. 04373

04477 **Brace, W. F.** Current laboratory studies pertaining to earthquake prediction, *in* Earthquake prediction—Proceedings of a symposium, Zürich, Switzerland, 1967: Tectonophysics, v. 6, no. 1, p. 75–87, illus., 1968.

Laboratories studies in source mechanism, microfracturing, and changes in rock properties under stress may be useful in earthquake prediction. Of processes which produce sudden stress drops in rocks, brittle fracture and frictional stick-slip are being currently studied. Both are accompanied by numerous small elastic shocks which are due to microfracturing; the pattern of microfracturing prior to brittle fracture differs from that before frictional sliding. Just before fracture the number and intensity of shocks increase markedly, and the locations from which larger shocks emanate cluster along the eventual fault plane; neither feature has been observed prior to frictional stick-slip. Large changes in sound velocity have been observed at certain phase changes, and electrical resistivity and magnetic susceptibility are strongly affected by stress.—*from* Author's abstract

04333 **Bradford, Douglas E.; Collins, Earl M.; Siesser, William G.** Mapa geológico de Guatemala—Cuilco (Hoja 1862 III G): Guatemala City, Guatemala, Inst. Geográfico Nacional, scale 1:50,000, 1968.

04472 **Bradford, G. R.; Bair, F. L.; Hunsaker, V.** Trace and major element content of 170 High Sierra lakes in California: Limnology and Oceanography, v. 13, no. 3, p. 526–530, tables, 1968.

One-gallon water samples were collected by helicopter from lakes in Sequoia, Kings Canyon, and Yosemite National Parks within a week in September 1965. Each sample was pretreated in the laboratory, in various ways described, to separate and concentrate trace elements for spectrographic analysis. The number of samples with concentrations, ranges, and detection limits of 15 elements in 170 High Sierra lakes is tabulated. A few lakes are unusual in their trace-element content, one suggesting it may be fed by a geothermal water source. A few samples contained traces of Ba, Co, Cr, Be, Cd, and Al, separately tabulated. Miller Lake in Yosemite Park, the most acid, has an exceptional value for the Fe:Mn ratio of 0.06. Further investigation is needed to relate analytical data to geological and other environmental factors of these lakes.—GDC

03985 **Bräunlich, P.** Thermoluminescence and thermally stimulated current—Tools for the determination of trapping parameters, Chap. 2.5 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 61–88, illus., tables, 1968.

Both thermoluminescence and thermally stimulated conductivity can be observed in geological materials, due to chemical impurities and structural defects which either activate or trap electrons. The glow curve provides a useful tool for the study of traps, but alone does not obtain desired information about the crystal microstructure. Kinetic theories, based on statistical models with additional transitions between defect levels and valence band, are discussed briefly. According to procedure used, 23 methods for determining trap depth fall into six groups. Attempt-to-escape frequencies must be determined to calculate capture cross sections. Few published reports evaluate applicability critically or make systematic comparison of the many different methods. There is close correlation between a certain method and the special model it was derived from, but no method known is independent of the reaction kinetic process.—GDC

04337 **Breed, William J.** The age of dinosaurs in northern Arizona: Flagstaff, Ariz., Mus. Northern Arizona, 45 p., illus., 1968.

The geologic history of northern Arizona during the Mesozoic is related. During this era, dinosaurs evolved, and the first birds and mammals appeared. Each of the three periods is discussed, formations and life during deposition of each series are described, and a reconstruction of the landscapes with characteristic animals and plants is included.—ESL

04033 **Breiner, Sheldon; Kovach, Robert L.** Search for piezomagnetic effects on the San Andreas fault, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 111–116, illus., 1968.

Investigations indicate that a change in subsurface stress should manifest itself as a change in the susceptibility and remanent magnetization of rock, therefore a change in the local geomagnetic field. A five-station network, 120 km long, has been placed along the San Andreas fault from San Bruno to Hollister. Signals are telemetered to a location where differences are recorded along with total field intensity. At five times, local changes in the magnetic field were observed, and in each case, and at no other time, abrupt creep displacements have occurred some tens of hours after the magnetic events. A higher density net of four stations recorded an event 16 hours before a displacement of 4 mm, and four days before local earthquakes. The source of the stress change is believed to be deep, in a ductile region.—ESL

04476 **Breiner, Sheldon; Kovach, Robert L.** Local magnetic events associated with displacement along the San Andreas fault (California), *in* Earthquake prediction—Proceedings of a symposium, Zürich, Switzerland, 1967: Tectonophysics, v. 6, no. 1, p. 69–73, illus., 1968.

The piezomagnetic properties or stress-dependence of magnetic susceptibility and remanent magnetization of rock indicates that there should be a one percent decrease in net magnetization in the direction of an applied compressive stress of 100 kg per cm^2. Through proper observation of the local geomagnetic field, it may be possible to utilize these effects for remote observation of changes in tectonic stress. To observe such phenomena, a telemetering array of five rubidium magnetometers was set up in a differential manner and has been operating for over two years on the San Andreas fault. Local events in the geomagnetic field were observed, having occurred 10 to 20 h before local creep displacements of the fault and at no other time.—*from* Authors' abstract

04451 **Brezonik, Patrick Lee.** The dynamics of the nitrogen cycle in natural waters [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 503B, 1968.

04307 **Bricker, Owen P.; Godfrey, Andrew E.; Cleaves, Emery T.** Mineral-water interaction during the chemical weathering of silicates, [Chap.] 6 *in* Trace inorganics in water—Am. Chem. Soc., 153d Ann. Mtg., Miami Beach, 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am. Chem. Soc. (Adv. Chemistry Ser. 73), p. 128–142, illus., tables, 1968.

The geochemical balance of a 103 acre acre watershed [north of Baltimore, Md.] underlain by silicate bedrock [Wissahickon pelitic schist] was investigated. Base flow composition of the stream water was essentially constant, but flood flows showed a decrease in concentration of silica, bicarbonate, and sodium and an increase in sulfate, magnesium, calcium, and potassium. Laboratory experiments indicate that fresh rock or soil reacts rapidly with distilled water and achieves a composition similar to the stream water, suggesting control of water composition by reaction with the silicate minerals. The alumino-silicate minerals react with CO_2 charged water to form kaolinite, releasing cations and silica to solution. The products of weathering are removed as particulate matter (0.28 metric tons per year)and dissolved material (1.5 metric tons per year).—Authors' abstract

Brietzke, Alex. *See* Konizeski, R. L. 04376

04172 **Broecker, Wallace S.** In defense of the astronomical theory of glaciation [summ.], *in* Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 139–141, illus., 1968.

Milankovitch (1920, 1930, 1938) presented the hypothesis that oscillations in climate during the past million years were caused by variations in summer insolation in the Northern Hemisphere resulting from the Earth's precession (22,000-year period) and variation in tilt (40,000-year period). An insolation curve for the past 150,000 years, compared with absolute chronologies for Atlantic Ocean temperatures and sea level, shows three prominent coincidences: The last two abrupt warmings that mark the end of oceanic cold periods coincide with the two most prominent warm insolation peaks. The present and three preceding high stands of the sea come just after the four prominent warm insolation peaks. The major glaciation maximum of 18,000 years ago follows the prominent insolation cold peak of 22,000 years ago.—VMJ

04210 **Brokaw, Arnold L.; Barosh, Patrick J.** Geologic map and sections of the Riepetown quadrangle, White Pine County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ–758, scale 1:24,000, 1968.

04098 **Broughton, Paul L.** Mineralogy of chlorite–talc schist from Washington, D.C.: Southeastern Geology, v. 9, no. 3, p. 151–155, table, 1968.

A Frantz Isodynamic Magnetic Separator was used to study the mineralogical composition of soapstone from northwest Washington, D.C. Chlorite, talc, magnetite, rutile, sphene, zircon, quartz, muscovite, and apatite are present. A norm calculation of the chemical analysis reveals a pyroxenite genesis.—Author's abstract

03953 **Brown, Robert D., Jr.; Wallace, Robert E.** Current and historic fault movement along the San Andreas fault between Paicines and Camp Dix, California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 22–39, illus., tables; discussion, p. 39–41, 1968.

The active San Andreas fault, in a zone with inactive faults, is recognizable from airphotos; much of it has been mapped. The Parkfield–Cholame earthquakes, 1966, were accompanied by fractures along 23 mi of the fault. Examination between Paicines and Parkfield confirmed the airphoto evidence; recent en echelon fractures in roads, and fence offsets show right-lateral slip. A uniform movement of about 0.8 inches per year is shown for the past 60 years. South of Cholame no recent displacement is found and there have been no earthquakes since 1857; between Parkfield and Cholame, rate of slip decreases southward. This can be interpreted as bringing the northern segment to a stable state reached in the north and south during the 1857 and 1906 earthquakes, or as denoting a new episode in the deformation pattern. Stress is probably accumulating south of Cholame, a likely place for a major earthquake.—ESL

Brown, Robert D., Jr. *See* Vedder, John G. 04056

04468 **Browning, David G.; Thorp, William H.; McElroy, John D.** Velocity and temperature profiles in Lake Superior: Jour. Geophys. Research, v. 73, no. 18, p. 6122–6124, illus., 1968.

Bathymetric and sound velocimeter measurements were made in Lake Superior in September 1967 in connection with the Hiawatha acoustic experiment. The temperature–depth data agree well with other reported results except for lower surface readings. The computed velocity profile indicates a velocity minimum at about 82 m. The resulting sound channel makes Lake Superior singularly attractive for the study of acoustic propagation in fresh water.—DBV

04150 **Bruce, Richard L.** Landslides in the Pierre Shale of South Dakota, *in* Highway geology symposium, 17th Ann.; Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 66–72, illus., 1968.

The majority of landslide activity in South Dakota occurs in the Pierre Shale. Because of the increase in construction in the outcrop area of the Pierre, it has received the major emphasis in the landslide study being conducted by the State. Landslides in the Pierre can be attributed to a combination of many factors acting through time. Varnes (1958) presented a summary of the factors which may lead to landslides either by increasing the shearing stresses acting on a slope or by decreasing shearing resistance of the slope-forming material. Many of these same factors are now acting on slopes in the Pierre Shale, and are known to affect slope stability. The only factor, however, that is common to all slopes developed in the Pierre Shale, is the character of the material.—Author's introduction

Brydon, J. E. *See* Kodama, H. 04330

04119 **Bryner, Leonid.** Proposed terminology for hydrothermal breccias and conglomerates: Econ. Geology, v. 63, no. 6, p. 692, 1968.

It is desirable to distinguish fragmental rocks actually intruded into other rocks ("hydrothermal intrusion-breccia," etc.) from those that may display cross-cutting relations, but originate by collapse due to corrosive action of fluids ("hydrothermal collapse breccia", etc.)—WSW

Bryson, Reid A. *See* Kutzbach, John E. 04171

04366 **Buchbinder, Goetz G. R.** Properties of the core-mantle boundary and observations of PcP: Jour. Geophys. Research, v. 73, no. 18, p. 5901–5923, illus., tables, 1968.

Study of PcP phases from eight explosions and three earthquakes shows effects that are caused by properties of the core-mantle boundary. A model with P and S velocities at the bottom of the mantle of 13.46 kmps and 7.30 kmps, respectively; with a P velocity at the top of the core of 7.5 kmps; and with a ratio of core density to mantle density of 1.0 will satisfy the observations of amplitude and change of initial phase of PcP. This is in sharp contrast to the structure of conventional models. One way to reconcile the new structure near the core-mantle boundary with other relevant information is to assume a model in which the lowermost mantle is inhomogeneous. The drop in P velocity across the core-mantle boundary may be explained by a step increase in mean atomic weight with little change in density.—*from* Author's abstract

Buffington, Edwin C. *See* Shepard, Francis P. 04552

Burchett, Ray. *See* Eversoll, Duane A. 04149

04045 **Burford, Robert O.** Evidence of recent strain in the San Andreas fault system from triangulation surveys [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 87–88, 1968.

Burford, Robert O. *See* Meister, Laurent J. 04370

04143 **Burgat, Virgil A.** Engineering geology in Kansas highway construction, *in* Highway geology symposium, 17th Ann., Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 1–13, 1968.

A survey is made of the various aspects of highway geology engineering which are carried on by the Geology Section of the State Highway Commission of Kansas. They include alignment determination, geology field data, classification of excavations, grade lines, balance factors, overbreakage, subgrading, highway backslope preparation, computer programming for classified excavations, ground-water problems, landslides, settlement, bridge foundations, and materials locations.—HRC

04028 **Burk, Creighton A.; Moores, Eldridge M.** Problems of major faulting at continental margins, with special reference to the San Andreas fault system, *in*

Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 358–374, illus., 1968.

The northeast Pacific basin is dominated by a series of major fractures, intersecting the coast at high angles, and represented by diverse structural features in their continental extensions. The San Andreas system is one of another series of major fractures, oriented parallel to the basin margins, possibly parts of marginal geosynclines. Both types of fractures are locally as old as Mesozoic, and both may represent old zones of weakness which localize response to varying stress fields or respond differently to a uniform stress field affecting different crustal types along them. Continental extensions of the transverse fractures are not offset by the San Andreas system, implying that strike-slip movement on the San Andreas is young and small. Its origin is probably similar to other peripheral fractures, perhaps the result of displacement along an old zone.—*from* Authors' abstract

04331 **Burke, J. J.** Pachylocrinids from the Conemaugh Group, Pennsylvanian: Kirtlandia, no. 3, 18 p., illus., 1968.

Four new species of *Plummericrinus*, pachylocrinid unadunate crinoids, are described. Three of these, *P. monongaliensis* from the Brush Creek Limestone, Monongalia County, W. Va., *P. emilyae* from the Ames Limestone, Carroll County, Ohio, and *P. pittsburghensis* from the Ames Limestone, Allegheny County, Pa., have bowl-shaped dorsal cups with slight interradial notches, pits at the corners of the cup plates, and generally resemble *P. colubrosus* (Moore); the fourth new species, *P. nettingi* from the Cambridge Limestone, Allegheny County, Pa., has a truncate cone-shaped cup and resembles *P. mcguiri* (Moore) in having prominent interradial notches and outflaring radials. *P. monongaliensis* has muscular articulations connecting anal X and right tube plate with the two overlying tube plates, indicating some flexion of the anal tube.—VMJ

04419 **Burroughs, Ernest.** Rio Vista gas field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1967, v. 53, no. 2, pt. 2, p. 25–33, illus., tables, 1968.

Sediments penetrated in the Rio Vista gas field range in age from Holocene to Upper Cretaceous; the deepest well was drilled to a total depth of 15,050 feet and penetrated approximately 2,200 feet of the Forbes Formation. The field is in the southern end of the Sacramento Valley geosyncline; general structure is a broad, flat, somewhat elongate faulted dome with a northwest-southeast axis. The most dominant subsurface feature is the Midland fault, from whose down-thrown block, most prolific gas production is derived. Producing zones are the Nortonville, Emigh, Capay, Hamilton, Anderson, Martinez Stringers, McCormick, Midland, M-5, and Petersen; available reservoir characteristics for most of these are tabulated.—MCM

04136 **Burt, D. M.** Control of oxygen fugacity during ore deposition in some pyrometasomatic zinc deposits [abs.]: Econ. Geology, v. 63, no. 6, p. 702, 1968.

04324 **Butterlin, Jacques; Moullade, Michel.** Les Orbitolinidae de l'Éocène de la région des Caraïbes [with English and Spanish abs.]: Archives Sci., v. 21, no. 1, p. 5–20, illus., 1968.

Orbitolinid foraminifera of conical shape with central pillar from the Eocene of Haiti and Yucatan, Mexico, are restudied in light of recent taxonomic revision of the family. A proposed key to the genera of Orbitolinidae, modified from Moullade (1965), is based primarily on the megaspheric embryonic apparatus, that of Dictyoconinae being simple bilocular, that of Orbitolininae being complex, with additional subembryonic zone preceding the first adult chambers. *"Dictyoconus" americanus* and *cookei* are assigned to *Heterodictyoconus*, n.gen., because, unlike the type *Dictyoconus*, they have a complex embryonic apparatus. *"Coskinolina" elongata* and *floridana*, with simple embryos, are assigned to *Dictyoconus* as here emended. Stratigraphic and geographic distributions are given.—VMJ

04373 **Byerlee, James D.; Brace, W. F.** Stick slip, stable sliding, and earthquakes—Effect of rock type, pressure, strain rate, and stiffness: Jour. Geophys. Research, v. 73, no. 18, p. 6031–6037, illus., table, 1968.

The magnitude of the stress drops that occur during frictional sliding on ground surfaces and on faults has been studied at confining pressures of as much as 5 kb. It was found that the stiffness of the loading system and the rate at which the load was applied had no effect on the magnitude of the sudden stress drops. Confining pressure and rock type were found to be the most important parameters. The results suggest that, if stick slip on a fault in the Earth produces earthquakes, the earthquakes should become more abundant and increasingly severe with depth. Also, if a fault traverses various rock types, then over part of the fault elastic buildup of stress prior to sudden movement may occur at the same time as stable creeping motion elsewhere on the fault.—*from* Authors' abstract

04082 **Byers, P. R.** Mineralogy and origin of the Eastend and Whitemud Formations of south-central and southwestern Saskatchewan and southeastern Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 203–204, 1968.

Cameron, J. R. *See* Zimmerman, D. W. 03962

03961 **Cameron, John R.; Zimmerman, D. W.; Rhyner, C. R.** Annealing characteristics of lithium fluoride, Chap. 8.4 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 471–484, illus., tables, 1968.

Experiments with pre-irradiation annealing of lithium fluoride, at 80°, 125°, 175°, 280°, 400°, and 600°C, have revealed that the absolute and relative heights of peaks can be changed. The changes cannot result from release of electrons from traps, but represent a change in the number of traps related to a given peak, the trapping efficiency or conversion efficiency from trapped electrons to photons. At the lower temperatures peak 5 decreases faster during pre-annealing than post-annealing; at higher temperatures these speeds are reversed. Assuming exponential decay, only one post-annealing mechanism can decrease the TL—thermal release of electrons. Overlap of peaks 6 and 5 gives the appearance of change in trap depth or frequency factor during annealing.—GDC

Campbell, F. A. *See* Evans, T. L. 04222

04338 **Campbell, Thomas H.; Sylvester, Robert O.** (editors). Water resources management and public policy: Seattle, Wash., Univ. Washington Press, 253 p., illus., tables, 1968.

Papers in this book were prepared for a seminar at the Graduate School of Public Affairs at the University of Washington, and represent an attempt to outline many of the relevant technical, scientific, and policy issues that should be considered in the management of water resources. A paper by J. W. Crosby, 3d, is cited separately.—MCM

04553 **Canada Geological Survey.** Aeromagnetic series, Kapuskasing, Districts of Algoma and Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 7100, scale 1:253,440, 1968.

04554 **Canada Geological Survey.** Aeromagnetic series, Hornepayne, Districts of Algoma, Thunder Bay and Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 7101, scale 1:253,440, 1968.

04555 **Canada Geological Survey.** Aeromagnetic series, Smoky Falls, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 7118, scale 1:253,440, 1968.

04556 **Canada Geological Survey.** Aeromagnetic series, Kenogami River, District of Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 7119, scale 1:253,440, 1968.

04557 **Canada Geological Survey.** Aeromagnetic series, Ghost River, Districts of Kenora and Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 7127, scale 1:253,440, 1968.

04558 **Canada Geological Survey.** Aeromagnetic series, Ogoki, Districts of Kenora and Cochrane, Ontario: Canada Geol. Survey Geophysics Paper 7264, scale 1:253,440, 1968.

04386 **Canright, James E.; Romans, Robert C.** A fossil flora from the Devonian of Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 8, 1968.

04389 **Cantwell, R. J.** Fossil *Sigmodon* from southeastern Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 9, 1968.

04560 **Carey, Andrew G., Jr.; Paul, Roger R.** A modification of the Smith-McIntyre grab for simultaneous collection of sediment and bottom water: Limnology and Oceanography, v. 13, no. 3, p. 545-549, illus., 1968.

Simultaneous collections of sediment, bottom water, and benthic organisms are desirable for ecological studies of the sea floor. A Smith-McIntyre bottom grab sampler, a Fjalic water-sampling bottle, and a deep-sea pinger with a bottom trip switch have been integrated for this purpose. The addition of hinged top plates that tightly cover the screen tops of the sturdy grab during ascent minimizes washing of the sample. Under heavy swell, a positive identification of bottom contact is provided by the magnet activated pinger which can be heard to depths of 2,800 m. The teflon-lined water bottle, in a protective frame, remains stationary while the thermometer rack rotates, and has excellent flushing characteristics. The operation of this combination sampler is simple and relatively trouble-free in sandy or softer substrates.—GDC

04510 **Carlson, C. E.** Triassic-Jurassic of Alberta, Saskatchewan, Manitoba, Montana, and North Dakota, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1969-1983, illus., 1968.

Of the total Triassic, only Lower Triassic continental and restricted-marine sediments were deposited in southern Saskatchewan, North Dakota, and southern Montana; maximum thickness (700 feet) is in North Dakota. In western Alberta, Lower, Middle, and Upper Triassic marine sediments are more than 4,000 feet thick. Lower Jurassic sediments are restricted to southwestern Alberta; Middle Jurassic rocks are the most widespread; and Upper Jurassic rocks, also widespread, are 7,000 feet thick in the Alberta trough and more than 700 feet thick in eastern Montana. Estimated ultimate production of oil from Triassic-Jurassic rocks is 470 million bbl of which more than 87 percent is stratigraphically trapped in strandline sandstone in southwestern Saskatchewan and north-central Montana.—BHK

04269 **Cartwright, Keros; McComas, Murray R.** Geophysical surveys in the vicinity of sanitary landfills in northeastern Illinois: Ground Water, v. 6, no. 5, p. 23-30, illus., 1968.

Electrical earth resistivity and soil temperature surveys were made near four sanitary landfills to test the possibility of detecting and tracing chemical or temperature alteration of ground water by leachates from buried refuse. Monitor wells provided data on water quality, levels, and movement. The resistivity survey, which was in homogeneous silty sand outwash, traced mineralized water from the landfill for more than 1,000 feet. Apparent resistivity values were one fourth those obtained from unaffected areas. The soil temperature survey showed a halo of higher temperatures around the landfill and indicated areas of surface recharge. The geophysical surveys show, in general, that chemically altered water is traceable in uniform earth materials where depth of the water table is constant.—*from* Authors' abstract

04276 **Carver, Riley D.; Johnson, Paul G.** Use of a spark source mass spectrograph for the general analysis of geological samples: Appl. Spectroscopy, v. 22, no. 5, p. 431-433, illus., tables, 1968.

For many years the spark source mass spectrograph has been used to analyze geological samples for trace impurities. The sensitivity variation between elements, a factor of two or three, has limited the use of this instrument in analyzing for major constituents. Experimental results show that these deviations are fairly

constant for individual elements in samples of the same general composition. These deviations can be used as empirical correction factors to improve survey-type analyses of geological samples. Measurements of major constituents and trace impurities in several geological materials are reported.—Authors' abstract

04347 **Case, Gerard R.** Fossils illustrated—An atlas of invertebrate and vertebrate fossils: Jersey City, N. J., Gerard R. Case, 32 p., illus., 1968.

The 185 illustrations include trilobites, other arthropods, annelid worms, insects, plant remains, microfossils, corals and sponges, crinoids, echinoids, cephalopods, belemnites, gastropods, brachiopods, pelecypods, mammals, marine mammals, dinosaurs, marine reptiles, archaic fish, elasmobranchs, and teleosts. A description and evolutionary history for each group are given in a brief text.—ESL

04375 **Cavender, Wayne S.** Geochemical exploration continues expansion at a rapid pace: Mining Eng., v. 20, no. 2, p. 65–68, 1998.

There is a growing recognition that applied geochemistry is a scientific tool and must be performed and interpreted by properly trained scientific personnel. A critical shortage of such personnel now exists and will probably continue into the near future. The rate of development of new geochemical techniques has leveled off, the probability of new breakthroughs is not high, and current research work in this field is quite limited. An improved technology and an increased understanding of the natural environment are needed. Numerous projects undertaken worldwide by federal and state governments, universities, and private industry during 1967 are reviewed.—MAC

Chao, T. T. *See* Jenne, E. A. 04225

Cherry, Carla W. *See* Lipper, Harold W. 04104

04063 **Chi, B. L.** A petrologic comparison of the Frenchman and Upper Edmonton Formations [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 210–211, 1968.

Chin, George E. *See* Langton, J. Roger. 04508

04138 **Chrismas, L.; Baadsgaard, H.; Folinsbee, R. E.; Fritz, P.; Krouse, H. R.; Sasaki, A.** Rb/Sr, S, and O isotopic analyses indicating source and date of the pyrometasomatic copper deposits at Craigmont, British Columbia [abs.]: Econ. Geology, v. 63, no. 6, p. 702–703, 1968.

Christiansen, Robert L. *See* Noble, Donald C. 04416

Christie, J. M. *See* Sylvester, A. G. 04434

04083 **Clack, W. J. F.** Sedimentology of the Mannville Group in the Cold Lake area, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 204–205, 1968.

04038 **Clark, Joseph C.** Correlation of the Santa Cruz Mountains Tertiary—Implications for San Andreas history, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 196–180, illus., 1968.

The lower Tertiary section southwest of the fault zone in the Santa Cruz Mts. shows more similarity to the correlative section in the northern Santa Lucia Range, 60 mi to the south, than to the lower Tertiary section directly across the fault. Although the Eocene section of Ulatisian and Narizian age in the Palo Alto area lithologically and faunally resembles the contemporaneous part of the Butano Sandstone to the southwest, and the middle Miocene section resembles the middle Miocene sequence across the fault, differences in heavy minerals suggest that these correlative sections were derived, at least in part, from different sources. In addition correlation of Miocene basaltic rocks across the fault in the Santa Cruz Mts. appears to be a mismatch. Present evidence does not preclude large-scale, post-Eocene lateral displacement along this segment.—*from* Author's conclusions

04226 **Clark, K. F.** Structural controls in the Red River district, New Mexico: Econ. Geology, v. 63, no. 5, p. 553–566, illus., tables, 1968.

Granitic stocks follow a mid-Tertiary, ENE-trending graben 2–4 miles wide, containing up to 3,000 feet of volcanics over Precambrian rocks. Hydrothermal alteration, particularly propylitic alteration, is widespread throughout the district, masking contact metamorphic effects. Molybdenite with pyrite occurs in disseminated and fissure-vein deposits (e.g., Questa mine) in a zone trending ENE along the graben. This zone is crossed by a NE-trending zone of younger pyrite-gold-chalcopyrite vein deposits and a NW-trending zone of still younger galena-sphalerite-silver vein deposits. The local trends can be related to major orogenic belts and lineaments of the Cordilleran region.—WSW

Cleaves, Emery T. *See* Bricker, Owen P. 04307

04237 **Clement, Stephen C.** Supergene copper concentration in altered plagioclase feldspar, Copper Canyon, Nevada: Econ. Geology, v. 63, no. 4, p. 401–408, illus., 1968.

Copper-bearing halloysite and chrysocolla are concentrated within plagioclase phenocrysts in the oxide zone of a small quartz monzonite porphyry intrusive in Copper Canyon, Battle Mountain, Nevada. The copper content of rock samples and of separated plagioclase phenocrysts as determined by X-ray spectroscopy indicates that the plagioclase contains most of the copper in the oxidized porphyry. The copper concentration within the plagioclase phenocrysts was mapped with a Heinrich X-ray Microprobe and shows a close correlation between metallic mineralization and zones of argillic alteration. Altered phenocrysts provided sites for secondary copper mineralization throughout the oxidized zone of the intrusive.—Author's abstract

04040 **Clifton, H. Edward.** Possible influence of the San Andreas fault on middle and probable late Miocene sedimentation, southeastern Caliente Range, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 183–190, illus., 1968.

Both middle and probable upper Miocene rocks contain evidence of abrupt changes in source material and relative local relief attributable to movement on the fault, which appears to correspond to the boundary of the depositional basin. Interfingering marine and continental sedimentary rocks compose the middle Miocene Branch Canyon Formation. The series of cyclic facies, with a periodicity of tens of thousands of years, is probably due to vertical fault movement. A salmon-colored sandstone of probable late Miocene age unconformably overlies the middle Miocene rocks. The closest granitic mass that could have been a source for this sandstone is in the San Emigdio Mts., 10–15 miles southeast.—ESL

Cloud, William K. *See* vonHake, Carl A. 04128

Cloud, William K. *See* vonHake, Carl A. 04336

Cluff, L. S. *See* Lundgren, Raymond. 04319

04051 **Cluff, Lloyd S.** Urban development within the San Andreas fault system, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 55–66, illus.; discussion, p. 66–69, 1968.

Most urban development along the San Andreas fault system has been proceeding without regard to future fault movements; many structures straddle active fault traces. Should another fault movement and attendant strong earthquake occur along an active fault in the San Francisco Bay area, many structures would be torn apart. The damage from fault displacement, however, would be minor when compared to the other types of earthquake damage (shaking and ground failure). As long as a structure is not astride the fault trace, it matters little whether it is next to the fault or several miles away. The ground condition and structural type and design are far more important than proximity when considering total earthquake risk.

Urban development should be allowed to proceed along and within active fault zones; however, there should be restrictions based on knowledge of the underlying geologic conditions.—*from* Author's summary

04532 **Cody, Robert Dow.** Boron content of late Paleozoic shale and mudstone from flanks of Ancestral Front Range, Colorado (abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 656B, 1968.

04533 **Cole, Joseph Glenn.** Stratigraphic study of the Cherokee and Marmaton sequences, Pennsylvanian (Desmoinesian), east flank of the Nemaha Ridge, north-central Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 65; B, 1968.

Collins, Earl M. *See* Bradford, Douglas E. 04333

04009 **Colquhoun, D. J.; Johnson, H. S., Jr.** Tertiary sea-level fluctuation, in South Carolina, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 105–126, illus., 1968.

The following major sea-level fluctuations are indicated: (1) rise in Cretaceous and relative stability through early Eocene (Black Mingo) time; (2) fall in pre-Claiborne; (3) rise in Claiborne (Congaree, McBean, and Santee) and relative stability through late Eocene (Barnwell), Oligocene (Cooper), and early and possibly median Miocene (Hawthorne) time; evidence of a change from warm pre-Oligocene seas to cooler waters during Oligocene and through early and possibly median Miocene; tectonic warping during this Oligocene–median Miocene interval; (4) fall; (5) rise to at least 190 feet in warm (Duplin) time; (6) slow fall to less than 140 feet in late Miocene–Pliocene; (7) pause or rise to 140 feet; (8) fall to (9) pause at 100 feet or lower; (10) fall to less than 0 feet with pause at 70 feet; and (11) rise to 45 feet (Sangamon).—*from* Authors' summary

Conkin, Barbara M. *See* Conkin, James E. 04329

04329 **Conkin, James E.; Conkin, Barbara M.** *Scalarituba missouriensis* and its stratigraphic distribution: Kansas Univ. Paleont. Contr.—Paper 31, 7 p., illus., table, 1968.

Scalarituba missouriensis, a worm burrow formally described by Weller (1899) from the "Vermicular Sandstone" [Northview Formation] of southwestern Missouri, apparently represents a monotypic genus, as no distinct morphological trend is discernible. It is widely distributed in North America in Ordovician and Mississippian–Permian sediments; previous records and first records (19 localities) are enumerated. *Scalarituba* may range throughout the Paleozoic, but it is recognizable only where the scalariform ridges are preserved; these commonly are excellently preserved in siltstones but poorly preserved or absent in finer- or coarser-grained sediments. The organism is interpreted as a marine worm that lived in great numbers probably in tidal flats, where it ate its way through the sediments leaving fillings in the burrow.—VMJ

Coolbaugh, David F. *See* Gómez, Manuel. 04115

Coombs, H. A. *See* Wheeler, H. E. 04481

Corchary, George W. *See* Fernald, Arthur T. 04177

04357 **Cord, Marian S.; Lojko, Matthew S.; Petersen, Jean D.** Microwave spectral tables—V. 5, Spectral line listing: U.S. Natl. Bur. Standards Mon. 70, v. 5, 533 p., table, 1968.

This volume is a listing of the spectral lines reported in volumes 1, 3, and 4 of the Microwave Spectral Tables. These lines are listed according to ascending magnitude of frequency and should provide a ready reference.—Authors' abstract

Cornwall, Henry R. *See* Hewett, D. F. 04221

04396 **Cotera, Augustus S., Jr.** Jointing and fracture analysis in the Little Rocky Mountains, Montana [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 26, 1968.

04378 **Cotter, R. D.; Bidwell, L. E.; VanVoast, W. A.; Novitzki, R. P.** Water resources of the Chippewa River watershed, west-central Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-286, 4 sheets, scale 1:250,000, 1968.

Sheet 1 contains a block diagram of the Chippewa River watershed, and diagrams and graphs for the water budget. Sheet 2 on ground water shows storage movement, quality, and availability as related to the geology. Ground water is available almost anywhere, principally from glacial drift, but to a limited extent from Cretaceous and Precambrian rocks. A chart indicates highest yields and specific capacities for wells in the Quaternary aquifers. Sheet 3 relates to surface water. Sheet 4 includes a map indicating chemical quality of water (high in calcium, magnesium, bicarbonate, and sulfate derived from glacial deposits), a chart showing municipal supply potential and water use, and summary of the water resources.—MCM

03986 **Cox, Allan; Doell, R. R.** Paleomagnetism and Quaternary correlation, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 253-265, illus., 1968.

Two types of geomagnetic field changes during the Quaternary are known. One involves sudden complete reversals of the geomagnetic field directions (seven have been dated by the K-Ar method), and the other (secular variation) involves uniform changes of a few tens of degrees, with periods of hundreds of years. The evidence for correlation is strong if sequences of lavas yield identical sequences of directions. Correlation based on reversals is permissive only, but because the Quaternary reversal time scale is known, certain time intervals are excluded (those periods known to have opposite polarity). In either case, different lavas with significantly different directions, or opposite polarity, are *not* correlative.—*from* Authors' abstract

04168 **Cox, Allan.** Polar wandering, continental drift, and the onset of Quaternary glaciation, *in* Causes of climatic change—INQUA-NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 112-125, illus., tables, 1968.

Continents occupied much of the region around the north pole during the late Paleozoic and late Cenozoic glaciations, but they also occupied polar regions at times when glaciation did not occur, so that polar continentality is not a sufficient condition for glaciation. Polar wandering has been linked to the onset of glaciation by theories suggesting that glaciation began as the rotation axis migrated toward potential glaciation-generating regions; but paleomagnetic evidence indicates that the rotation axis has been within the present polar region at least ten times longer than the Quaternary glaciation interval. Rates of continental drift are too small to permit changes in configuration of continents sufficient to cause Quaternary glaciation. The possibility remains that vertical movements of land masses at the end of the Pliocene may have been significant in initiating Quaternary glaciation.—*from* Author's abstract

Cox, Allan. *See* Doell, Richard R. 04362

04346 **Cox, Donald D.** A late-glacial pollen record from the West Virginia-Maryland border: Castanea, v. 33, no. 2, p. 137-149, illus., 1968.

A pollen diagram was constructed from a 3.5 m sediment column taken at Cranesville Swamp on the W. Va.-Md. border. The swamp began its development as a lake during a major advance of the Wisconsin ice. A subarctic vegetation is indicated from the bottom 1.5 m. Two subdivisions are designated as zones 1 and 2—zone 1 characterized by more herbaceous pollen than tree pollen and zone 2 by advances of spruce, fir, and pine. Above these, 2 m of deciduous forest zones, designated as C1, C2, and C3 are present. C1 is characterized by hemlock, birch, and oak; a maximum of chestnut and birch identify C2. Modes in beech and hickory mark the boundary between C2 and C3. Maxima in oak, birch, and spruce along

with a rise in herbaceous pollen distinguish C3. The lake probably persisted until C2 time. Since then the swamp has existed as a shallow lake during moist years and a marsh during dry years.—*from* Author's summary

04534 **Craig, William Warren.** The stratigraphy and conodont paleontology of Ordovician and Silurian strata, Batesville district, Independence and Izard Counties, Arkansas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 657B, 1968.

04195 **Crawford, Carl B.** Recent quick-clay studies—[No.] 6, Quick clays of eastern Canada: Eng. Geology—Internat. Jour., v. 2, no. 4, p. 239–265, illus., table, 1968.

This paper describes the results of research carried out during the past 15 years on the quick clays of eastern Canada. The mineral composition and structure of these clays is similar to that of other glacial marine clays, but they often exist with an unusually low salt content in the pore water. There is evidence of strong rigid bonds between particles of those deposits that are overconsolidated. The bonds are broken when the soil is loaded and this may lead to large volume changes or to exceptional loss of strength if drainage is not permitted. Some studies have been made on the physico-chemical characteristics of the soil and on its fabric but most of the research to date has involved laboratory and field observations of the response of the soil structure to stress changes. The important influence of rate of loading has revealed the need of careful interpretation of laboratory tests for field application.—Author's abstract

Creel, John P. *See* Roedder, Edwin. 04223

04467 **Cremer, E. A., 3d.** Gravimetric survey, *in* Geology and ground-water resources of the Deer Lodge Valley, Montana: U.S. Geol. Survey Water-Supply Paper 1862, p. 27–29, 1968.

A gravity survey indicates there is a large fault along the eastern side of the Deer Lodge Valley and probably a smaller one along the western side. These faults indicate a tectonic origin of the Deer Lodge Valley. The maximum depth of fill is more than 5,500 feet east of Anaconda. The depth of fill decreases to the north. [A gravity map and sections of the area are included.]—*from* Author's summary

04157 **Crickmay, C. H.** Lower Devonian and other coral species in northwestern Canada, Art. 14: Calgary, Alberta, Evelyn de Mille Books, 9 p., illus., 1968.

The occurrence of Lower Devonian fossils of Silurian aspect in northwestern Canada are discussed in the hope that some of the confusion surrounding relationships, particularly of certain early Middle Devonian rugose corals already described and named, can be resolved through consideration of their origins from Silurian families. Lower Devonian phylogenetic links in some of these families of Rugosa can now be made known with the hope that, as their positions in the Devonian System are established, the species will have value in correlation. Three rugose coral families discussed provide two new genera and seven new species; in addition five species described in an earlier work are reviewed. Some of the Hexagonariae named in 1960 do not belong to that genus or family, and the species called *sperabilis* in 1962 is neither a *Lyrielasma* nor a Spongophyllid.—MST

04278 **Cridland, Arthur A.** *Alethopteris ambigua* Lesquereux, a Pennsylvanian pteridosperm from Missouri, U.S.A.: Linnean Soc. London Jour., Botany, v. 61, no. 384, p. 107–111, illus., 1968.

Transfers and macerations from new material of *Alethopteris ambigua* Lesquereux, 1879, from the Desmoinesian Tebo coal and Verdegris Formation near Clinton and Windsor, Henry County, Mo., reveal it as a xeromorphic plant. The papillose lower epidermis of each pinnule is sheltered by incurved pinnule margins and a bladelike extension of the midvein, both fringed by marginal hairs. Cellular outlines are discernible except on the cuticles of the lower epidermis. The cuticle covering the exposed surfaces is substantial; wrinkles in the cuticle of the upper epidermis suggest that the pinnules were fleshly; additional thickenings of the cuticle of the upper epidermis may represent bases of hairs or glands.—VMJ

04512 **Crosby, Gary W.** Vertical movements and isostasy in western Wyoming overthrust belt, *in* Rocky Mountains–Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 2000–2015, illus., table, 1968.

The miogeosyncline in southeastern Idaho subsided slowly and filled with about 50,000 feet of Paleozoic and Mesozoic sediments, whereas the adjacent Wyoming shelf remained relatively positive. During the development of the overthrust belt, Early Cretaceous to early Tertiary, the area of the miogeosyncline was uplifted at least 50,000 feet and more than 20,000 feet of Cretaceous sediment, derived from the rising highlands, accumulated in a foredeep basin in western Wyoming. The rising lands were progressively overthrust on the subsiding area. After overthrusting, the area of the foredeep basin rose more than one mile and the area of the highlands subsided an unknown amount. Isostatic interpretations indicate that the latest phase of opposed vertical movements is still active. These recent vertical movements generally have reversed the dip directions of the major thrust surfaces from east to west.—EAM

04325 **Crosby, James W., 3d.** Ground-water hydrology of the Pullman–Moscow basin, Washington, *in* Water resources management and public policy (T. H. Campbell and R. O. Sylvester, editors): Seattle, Wash., Univ. Washington Press, p. 93–109, illus., 1968.

Declining ground-water levels in the Pullman–Moscow basin near the eastern margin of the Columbia Plateau led to a study of the hydrology of the region. C–14 studies indicate that the upper water-producing zones are being depleted at rates well in excess of recharge. Limited recharge is occurring in the Pullman subbasin, but recent recharge is not demonstrable in the Moscow subbasin. Future municipal drilling should be directed to the deep artesian zone, a largely untapped resource expected to contain greater reserves than the shallow system and to meet increased pumping needs for at least a decade. This is essentially a stored body of water and pumping may not induce significant amounts of recharge; an analysis of the performance of the deep system must wait until pumpage has continued long enough to produce measureable effects.—MCM

04026 **Crowell, John C.** Movement histories of faults in the Transverse Ranges and speculations on the tectonic history of California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 323–338, illus.; discussion, p. 338–341, 1968.

Tectonic history, particularly in the Transverse Ranges, can be explained by assuming the continent has moved westward with respect to the crest of the East Pacific Rise, which now lies inland beneath the Gulf of California and the Great Basin. During the Mesozoic a trench lay between the crest and the continental margin and received thick debris directly on oceanic crust which was carried eastward by mantle currents. After elevation, huge masses of Mesozoic rocks in places have moved down slope. In other places continental rocks were thrust over sediments forming a source for Mesozoic granitic rocks. By the end of the era, the continental margin lay astride the crest and fragmentation ensued with coastal continental blocks moving northwestward along strike-slip faults of the San Andreas system. From the Oligocene on, this tectonic style dominated as the crest of the rise moved eastward.—*from* Author's abstract

04302 **Crowley, William Patrick.** The bedrock geology of the Long Hill and Bridgeport quadrangles, with maps: Connecticut Geol. and Nat. History Survey Quad. Rept. 24, 81 p., illus., tables, geol. maps, 1968.

The quadrangles are underlain by 16 northeast-trending units of interlayered meta-igneous and metasedimentary rocks assigned to nine formations, making up two groups, the basal group and the Hartland Group. It is suggested that the entire section is Middle to Late Ordovician, and a volcanic origin is proposed for a large part of the section. A system of five major folds appears to be the result of one major deformation; folds are recumbent in the northwest. Staurolite and kyanite are present on both sides of the first sillimanite isograd, paralleling the regional trend of the units. A second isograd crosses the northwest corner of the Long Hill quadrangle. Sulfide and scheelite deposits occur in a thin zone at the top of

the basal group. Modal analyses are tabulated; a geologic map of south-central Connecticut, and cross sections accompany the quadrangle maps.—*from* Author's abstract

04064 **Cruden, D. M.** Structural analysis of part of the Brazeau Range anticline near Nordegg, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 211, 1968.

04053 **Cummings, Jon C.** The Santa Clara Formation and possible post-Pliocene slip on the San Andreas fault in central California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 191–206, illus., tables; discussion, p. 206–207, 1968.

The late Cenozoic nonmarine Santa Clara Formation, a fluvial deposit of pebble and cobble gravel with some sand and silt, rests unconformably on beds of Cretaceous to late Pliocene age, and is overlain unconformablz by late Pleistocene terrace gravels. Eight lithofacies are distinguished by composition of the gravels, four distributed along the San Andreas fault. Distinctive gravels of the Corte Madera facies, in the wedge between the San Andreas and Pilarcitos faults, are discussed in detail and tabulated; the source must have been within a few kilometers to the southeast. There are no known outcrops comparable to the clasts in the Corte Madera in the adjoining terrane. Nearest existing rocks from which the detritus could have come are Upper Cretaceous strata lying several tens of kilometers to the southeast, on the northeastern side of the San Andreas, suggesting a movement of one to three centimeters a year.—ESL

Curray, Joseph R. *See* Normark, William R. 04297

04246 **Curry, Robert R.** California's Deadman Pass glacial till is also nearly 3,000,000 years old: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 10, p. 143–145, illus., 1968.

Well-preserved glacial till, found along the crest of the Sierra Nevada in Mono and Madera Counties, lies on an andesite flow dated at 3.1 m.y., and is overlain by a quartz latite flow 2.7 m.y. old. The overlying flow is cracked and broken indicating that it may have been extruded onto the glacial ice. The oldest Pleistocene till on Antarctica, dated at 2.7 m.y., suggests that there may have been a worldwide climatic change. The till is made up of fragments from the Ritter Range, about eight miles west, and is believed to have been deposited along the eastern margin of an icecap formed on what was then a high plateau, remnants of which still exist. There have been at least six subsequent periods of glacial advance.—ESL

Cushing, E. M. *See* Boswell, E. H. 04517

04274 **Cuttitta, Frank; Rose, Harry J., Jr.** Micro X-ray fluorescence spectroscopy—Selected geochemical applications: Appl. Spectroscopy, v. 22, no. 5, p. 423–426, tables, 1968.

Comprehensive and accurate data on relative and absolute abundances of elements are critical to better understanding of principles governing crustal distribution and migration processes. Many geochemically coherent pairs or groups are difficult to determine chemically. Microanalytical methods combining chemical and X-ray fluorescence techniques have been developed to determine the elements rapidly and accurately, and to provide total analyses of milligram quantities of rare specimens. The solution-dilution method is free of matrix effects and is adaptable to analysis of trace or major constituents. These methods have proved invaluable in microdetermination of Sc, Y, and individual rare-earth elements on as little as 1 mg of total sample. Other applications have been determination of iron in silicates, bromine and iodine in well waters, and total analysis of small amounts of chromium, sulfide, and carbonate minerals.—*from* Authors' abstract

Cuttitta, Frank. *See* Rose, Harry J., Jr. 04275

04236 **Dahlberg, Eric C.** Application of a selective simulation and sampling technique to the interpretation of stream-sediment copper anomalies near South Mountain, Pennsylvania: Econ. Geology, v. 63, no. 4, p. 409-417, illus., tables, 1968.

Copper content of 227 sediment samples from an area of 65 sq mi was determined spectrometrically. "Quantitative models were constructed to estimate the expression of (1) cultural features, (2) known faults, (3) metabasaltic rocks, and (4) existing prospects and workings," and these models were subtracted from the copper distribution model, or otherwise compared. The cultural-features model permitted removal of some anomalies that were not significant geologically. The distribution of metabasaltic rocks is more strongly reflected in stream-copper concentrations than the faults. The method is useful for dealing objectively with specified factors in geochemical prospecting.—WSW

03993 **Dalrymple, G. B.** Potassium-argon dating in Pleistocene correlation, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 175-194, illus., tables, 1968.

K-Ar data determine the time, t_a, when rock or mineral begins to quantitatively trap argon, provided the following are valid: K-40 decays to A-40 at a constant rate, the composition of argon in the rock or mineral at t_a is known, there is no loss or gain of K-40 or A-40 since t_a, and there is no isotopic fractionation of K-40 in nature. Assumptions one and four, tested in the laboratory, contribute no significant error to dating. In Quaternary sequences, K-Ar dating is generally confined to volcanic rocks, although glauconite has been used to date the time of authigenesis in marine rocks. Theoretically, K-Ar dating can be extended to rocks only a few thousand years old, but practical limitations restrict its use to rocks greater than 10^5 years old.—*from* Author's abstract

03948 **Damon, P. E.** Radioactive dating of Quaternary tephra [with German abs.], *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 195-206, illus., table, 1968.

The two methods which have been applied to tephrochronology are the C-14 and the K-Ar methods. The limit on the range of the C-14 method is the smallest amount of uncontaminated C-14 that can be extracted; isotopic concentration might allow for an extension to 100,000 years, but the sensitivity of the old samples to contamination probably does not warrant the effort. A limitation on accuracy is the constancy of C-14 concentration in the atmosphere; variations up to 13 percent have occurred in the past 6,000 years. The relative error due to such fluctuations is inversely proportional to the age of the sample. The ultimate limit on the K-Ar method is the precision of correction for atmospheric Ar-40. This occlusion of excess initial Ar-40 during mineral genesis makes K-Ar dating within the range of C-14 dating very nebulous. Accuracy of K-Ar dating for the Quaternary has yet to be established.—*from* Author's abstract

04140 **Damon, Paul E.** Radiocarbon and climate—A comment on a paper by H. Suess, *in* Causes of climatic change—INQUA-NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 151-154, illus., 1968.

Atmospheric radiocarbon fluctuations of ±2.5 percent and temperature fluctuations of ±0.8°C during the Christian era are consistent with a solar activity-solar modulation theory as suggested by Suess. Higher than average sunspot frequency is correlative with higher average annual temperature due to increase in the solar constant, whereas lower atmospheric C-14 concentration is consistent with a lower Q due to solar modulation of interplanetary magnetic fields. The fivefold greater atmospheric C-14 fluctuations in B.C. time, directly correlated with atmospheric temperature, must be the result of a different mechanism. The assumption of a much higher atmospheric C-14 concentration during the last glacial episode is inconsistent with tree-ring data, varve chronology, and production rate-decay rate relations.—*from* Author's abstract

04167 **Damon, Paul E.** The relationship between terrestrial factors and climate, *in* Causes of climatic change—INQUA—NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 106–111, illus., table, 1968.

Epeirogeny, with a time scale (periodicity) of 250 m.y., has had profound influence on climate during geologic time: during maximum transgression of epicontinental seas, mild, uniform climates prevail; during maximum regression, climates are cooler and more differentiated. Orogeny, with a time scale of 40 m.y., has a similar but shorter-term effect on climate. Orogeny continues during both regressive and transgressive phases of epeirogeny; though not a cause by itself, orogeny coincident with maximum continental upwarp during the regressive phase of epeirogeny causes onset of continental glaciation. However, this time scale is too long to explain glacial–interglacial oscillations, which probably are caused by a combination of astronomic factors, such as geometric variations and flickering sun. Volcanic dust output lacks periodicity to match the oscillations.—VMJ

03982 **Daniels, Farrington.** Early studies of thermoluminescence in geology, Chap. 1.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 3–11, 1968.

Thermoluminescence, probably first reported 300 years ago, was well recognized early in 1900. Researches reviewed here have been concerned with its practical laboratory uses, without attempting to determine the complete mechanisms underlying the phenomena. At the University of Wisconsin lithium fluoride was chosen for study of kinetics of thermoluminescence of crystals activated by X-rays. References to natural thermoluminescence of certain materials, its mysterious variance depending on where minerals were found, and theory of radioactivity led to interesting field trips and to extended research (1949–59) on 8,000 samples of rocks and over 100 laboratory crystals and glasses. Some of the published papers deal with stratigraphy, laboratory crystals, geochemistry of uranium, energy storage, pressure effects, age determinations, and aragonite–calcite. Further research possibilities are suggested.—GDC

Daniels, R. B. *See* Nettleton, W. D. 04191

Daniels, R. B. *See* Nettleton, W. D. 04218

Dass, A. S. *See* Boyle, R. W. 04232

04293 **Davidson, Donald M., Jr.; Kerr, Paul F.** Uranium bearing veins in Plateau strata, Kane Creek, Utah: Geol. Soc. America Bull., v. 79, no. 11, p. 1503–1525, illus., tables, geol. map, 1968.

Uranium deposits of the Colorado Plateau are commonly peneconcordant, enclosed in sedimentary strata, and lacking hydrothermal feeder dikes. Deposits at Kane Springs, Utah, where vertical uranium bearing fractures penetrate older strata, are among the few exceptions. Associated with the uranium in the veins are clay minerals, chlorite, and development of micaceous foliation. Field and laboratory studies indicate that two periods of fluid invasion caused mineral alteration: an early bleaching was followed by localized green-gray clay-mineral alteration that closely followed steeply inclined fault planes. These fault planes are uranium bearing and contain mineral assemblages that indicate that moderate- to low temperature solutions prevailed during ore formation.—*from* Authors' abstract

Davies, David K. *See* Berg, Robert R. 04506

04065 **Davies, E. J. L.** Ordovician and Silurian of the northern Rocky Mountains between Peace and Muskwa Rivers, British Columbia [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 211–213, 1968.

04522 **Davis, G. L.; Hart, S. R.; Tilton, G. R.** Some effects of contact metamorphism on zircon ages: Earth and Planetary Sci. Letters, v. 5, no. 1, p. 27–34, illus., tables, 1968.

Zircons from Precambrian metasediments and granite adjacent to Tertiary intrusives show highly discordant U–Pb ages, with the degree of discordance directly related to the distance from the intrusive contact. The discordant ages define 1615–60 and 1430–60 million year chords on a concordia diagram. As the contact is approached (1) uranium and thorium contents of zircons increase, (2) radiogenic lead content decreases, and (3) the zircons become progressively more euhedral. This episodic discordance may be explained on the basis of crystallization, recrystallization, or episodic diffusion models, or a combination of these.—Authors' abstract

04340 **Davis, Johnnie L.** Meteorologic and hydrologic relationships on the Great Salt Plains of Oklahoma: Oklahoma Geology Notes, v. 28, no. 5, p. 163–168, illus., 1968.

Basic field data were collected during the period June 17–30, 1968, to investigate conditions affecting growth of "hourglass" selenite crystals. The Plains is a deltaic river deposit with a maximum thickness of 27.5 feet. The ground water is highly mineralized and salt and gypsum crystals are being precipitated on, or just below, the surface; ground-water levels are 0.5 feet below land surface. Hygrothermographs for a site off and one on the Plains are superimposed. Temperature traces parallel each other but relative humidity traces cross each other periodically and the relationships are the reverse of what would be expected. Reversals in water-level trends correlate with periods of evaporation and dehumidification.—ESL

04075 **Davis, Margaret.** Pollen grains in lake sediments—Redeposition caused by seasonal water circulation: Science, v. 162, no. 3855, p. 796–798, illus., 1968.

Annual pollen deposition per unit area measured in sediment traps is two to four times greater than deposition measured in surface sediment cores. The difference is due to repeated redeposition of pollen from the sediment surface during seasons of water circulation. This process reduces variations in the percentages of different pollen types in sediment, but causes differences in the total amount of pollen accumulated in various parts of the lake basin.—Author's abstract

Davis, R. W. *See* Olive, Wilds W. 04204

04334 **Davis, R. W.** Availability of ground water in the parts of the Arlington and Wickliffe SW quadrangles in Jackson Purchase region, Kentucky: U.S. Geol. Survey Hydrol. Inv. Atlas HA–183, scale 1:24,000, section, text, 1968.

Sufficient supplies of ground water for domestic, public, and industrial needs are available in the map-area, mainly at moderate depths in alluvium of the Mississippi River valley, the shallow Eocene aquifer in the remainder of the area, and a deeper, presently untapped Eocene aquifer underlying the entire area. The quality of the water is good, commonly less than 200 gpm dissolved solids, but variable in several components.—MCM

04228 **Dawson, J. B.** Recent researches on kimberlite and diamond geology: Econ. Geology, v. 63, no. 5, p. 504–511, illus., 1968.

New developments since Wyllie's (1967) book include new discoveries (India, USSR); observations on zoning of xenoliths in pipes; a new mineral (amakinite) and several minerals reported from kimberlite for the first time; new data on composition and geochemistry of kimberlite; observations on maximum size, abundance, and banding of xenoliths. New isotopic ages (South Africa, U.S.A.) indicate that although xenoliths may give Precambrian dates, kimberlite minerals crystallized at times that fit field relations. Researches on diamond give data on included material (nitrogen, pyrrhotite, rutile) and new syntheses (one in the graphite stability field). A scheme for appraising diamond deposits is based on kimberlite composition and diamond morphology.—WSW

Day, J. J. *See* Levinson, A. A. 04521

04392 **Deal, Edmond G.** Petrochemistry of the San Francisco Peaks volcanics [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 25, 1968.

04187 **DeBremaecker, J.-Cl.** Comment on paper by LeRoy M. Dorman, "Anelasticity and the spectra of body waves" [1968]: Jour. Geophys. Research, v. 73, no. 22, p. 7147, 1968.

DeBremaecker suggests the following two explanations for the surprisingly high value of Q obtained by Dorman (ibid., v. 73, p. 3877–3883, 1968): (1) The waves under analysis may be head waves; hence, the geometrical spreading law does not hold. (2) The Q computed by Dorman is not the best fit of the data in the least-squares sense; instead it is the best fit after a logarithmic transformation.—KAF

04439 **Degens, E. T.; Guillard, R. R. L.; Sackett, W. M.; Hellebust, J. A.** Metabolic fractionation of carbon isotopes in marine plankton—[Pt.] 1, Temperature and respiration experiments: Deep-Sea Research, v. 15, no. 1, p. 1–9, illus., tables, 1968.

Experiments on fractionation of stable carbon isotopes by marine phytoplankton cultures—*Skeletonema costatum, Cyclotella nana*—suggest that both algae utilize molecular CO_2 rather than carbonic acid, bicarbonate, or carbonate. With air CO_2 there is an increasing drain on molecular CO_2 supply as the culture becomes more dense, as the pH rises, and with increase in temperature. Consequently, C-13 enriched molecular CO_2 is released from bicarbonate and taken up by plants. There is no need to postulate temperature-sensitive enzymatic reactions to explain observed fractionations with change in water temperature. When molecular CO_2 is sufficiently abundant, there is constant fractionation of about 19 per mille between CO_2 and cells at all temperature levels. Isotope fractionation in living material occurs in both synthetic and degenerative processes.—*from* Authors' abstract

04440 **Degens, E. T.; Behrendt, M.; Gotthardt, B.; Reppmann, E.** Metabolic fractionation of carbon isotopes in marine plankton—[Pt.] 2, Data on samples collected off the coasts of Peru and Ecuador: Deep-Sea Research, v. 15, no. 1, p. 11–20, illus., tables, 1968.

Marine plankton, collected in 1966, has been examined for the carbon isotope composition of its major biochemical constituents. Relative to sea water bicarbonate, the hemicellulose, the proteins, and the pectins are enriched in C-12 by about 17 per mille. The C-12 enrichment for cellulose and lignin amounts to 23 per mille, and the corresponding value for $CHCl_3$-extractable lipid fraction is 30 per mille. Aside from this biological significance in studies on the pathway of carbon during photosynthesis, this observation is of geochemical interest in work concerned with diagenesis of organic matter in sediments.—*from* Author's abstract

04256 **Delevoryas, T.** Some aspects of cycadeoid evolution: Linnean Soc. London Jour., Botany, v. 61, no. 384, p. 137–146, illus., 1968.

First definite remains of the order Cycadeoidales [Bennettitales] appear at the beginning of the Mesozoic; extinction occurred at the end of the Cretaceous. Assuming that the characters most frequently present in a group of related plants are primitive ones, the most primitive cycadeoids probably had slender, elongated, branched stems, with numerous leaves, and pollen-bearing compound sporangia on leaflike structures. The most likely ancestral form, on the basis of known Paleozoic fossil plants, was a pteridosperm. Cycadeoid cones may have originated in one of three ways: (1) from portions of leaf systems displaced by telescoping of the stems to the axil of another leaf; (2) from fertile axillary branches; and (3) from branches arising from leaves.—*from* Author's abstract

04495 **Dennis, Robert L.** *Rhabdoxylon americanum* sp. n., a structurally simple fern-like plant from the Upper Pennsylvanian of Illinois: Am. Jour. Botany, v. 55, no. 8, p. 989–995, illus., 1968.

The new species of *Rhabdoxylon* from a coal ball in the Upper Pennsylvanian of southern Illinois, is based on five specimens consisting of stems bearing spirally arranged leaves and numerous randomly-distributed adventitious roots. The haplostelic stems branch by equal dichotomies and bear foliar traces which arise as unequal dichotomies of the stele. Leaf traces possess a circular cross section and one adaxial protoxylem strand. The characteristics of exclusively primary

tissues, diarch adventitious roots, centrarch haplosteles with simple scalariform pitting, and the nature and arrangement of leaf traces, suggest a fern or fern-like plant. At present it is not possible to determine whether the simple structure has come about by phyletic reduction or whether it is a primitive condition.—*from* Author's abstract

Denny, M. *See* Springer, D. 04372

04124 **Desborough, George A.; Anderson, Alfred T.; Wright, T. L.** Mineralogy of sulfides from certain Hawaiian basalts: Econ. Geology, v. 63, no. 6, p. 636–644, illus., table, 1968.

Polymineralic sulfide grains, composed principally of Fe sulfide and Fe–Cu sulfide, with magnetite, have been studied mineragraphically and by electron probe, and interpreted in terms of experimental data for the system Fe–Ni–Cu–S. The three main phases are monosulfide solid solution, a Cu–Fe sulfide (solid solution) with composition near cubanite, and Ti-free magnetite. The grains are believed to represent phases unmixed from an immiscible liquid phase in the basalt magma. Compositions of the two main sulfide phases suggest quenching below 700°C. Most of the Ni has been retained in the monosulfide solid solution by rapid quenching.—WSW

Devata, M. *See* Stermac, A. G. 04258

04017 **Dibblee, Thomas W., Jr.** Displacements on the San Andreas fault system in the San Gabriel, San Bernardino, and San Jacinto Mountains, southern California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 260–276, illus.; discussion, p. 276–278, 1968.

In the Transverse Range region, the San Andreas and several other faults constitute a complex system of anastomosing faults along or against which have formed sediment-filled basins and the highest ranges on the California coast. Determination of the character and amount of cumulative movement on these faults from the distribution and structure of the pre-Tertiary crystalline rocks transected by them is discussed. Each group of mountains and the principal faults affecting them are described and shown on geologic sketch maps. It is concluded that the San Andreas, mainly through its north branch through the San Bernardino Mts., is a crustal break that can be mapped continuously through southern California. The fault has been active in the late Cenozoic, and movement is mainly right slip; amounts vary locally.—ESL

04039 **Dickert, Paul F.** Phosphatic facies across the San Andreas fault [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 181–182, 1968.

Dickinson, William R. *See* Stanford Univ. School Earth Sci. 03956

Doe, Bruce R. *See* Muffler, L. J. Patrick. 04462

Doell, R. R. *See* Aitken, M. J. 03971

Doell, R. R. *See* Cox, Allan. 03986

04362 **Doell, Richard R.; Cox, Allan.** Reply [to comments by S. K. Runcorn on the term "virtual geomagnetic poles" (1968)]: Jour. Geophys. Research, v. 73, no. 18, p. 6139, 1968.

Doell and Cox are unable to find any dictionary entry similar to Runcorn's definition of "virtual" as "that which is opposed to real" (ibid., p. 6138). Their term virtual geomagnetic pole (VGP) is not intended to replace such terms as "paleomagnetic pole" or "past geographic pole," but describes only the simple mathematical mapping of a field direction into an equivalent "pole" and is free of any other inference. It is convenient to use the term VGP when it is inappropriate to make the usual assumptions about past dipole symmetry of the geomagnetic fiel..

parallelism with the axis of rotation, or whether or not the data have averaged out possible contributions from the nondipole field.—DBV

04166 **Donn, William L; Ewing, Maurice.** The theory of an ice-free Arctic Ocean, *in* Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 100–105, 1968.

The original Ewing–Donn (1956) model of Arctic Ocean control of glacial interglacial stages has been revised. The importance of an ice-free Arctic Ocean is in initiating high-latitude glaciation, followed by glacial growth to lower latitudes in those regions having adequate moisture supply. The Arctic Ocean surface would freeze once a good-sized peripheral ice sheet formed, and would then cease to nourish the continental ice sheets. A glacial stage is terminated not as a consequence of decreased heat exchange with the warmer North Atlantic as sea level was lowered, but by decreased atmospheric moisture supply consequent upon lowered temperature of the North Atlantic. Geologic evidence of glaciation in the Pliocene diminishes the time lag between Arctic centering of the magnetic pole in the Miocene and the beginning of glaciation.—VMJ

04535 **Doyle, Roger Whitney Stevens.** Eh and thermodynamic equilibrium in environments containing dissolved ferrous iron [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 658B, 1968.

Drew, Isabella Milling. *See* Kerr, Paul F. 04194

04108 **Drewes, Harald.** New and revised stratigraphic names in the Santa Rita Mountains of southeastern Arizona: U.S. Geol. Survey Bull. 1274-C, p. C1–C15, illus., table, 1968.

Recent work provides the basis for establishing a stratigraphic column in the Santa Rita Mountains of Santa Cruz and Pima Counties of southeastern Arizona. Thirteen formations of this column are here defined and one is revised. One new formation is a Precambrian granodiorite. Ten new formations are Mesozoic units that include plutonic, volcanic, and continental sedimentary rocks. The revised formation is the Upper Cretaceous Fort Crittenden Formation of Stoyanov (1949), dominantly a sedimentary unit. Two new formations are volcanic and sedimentary rocks of Tertiary age. Many radiometric dates supplement the sparse fossil record in corroborating or redefining the ages that had been assigned to many of the units on the basis of their geologic relations and in establishing the ages of other units.—Author's abstract

04496 **Duke, Thomas W.; Willis, James N.; Wolfe, Douglas A.** A technique for studying the exchange of trace elements between estuarine sediments and water: Limnology and Oceanography, v. 13, no. 3, p. 541–545, illus., 1968.

Continuous exchange is an important part of the biogeochemical cycling of trace elements in the estuarine environment, and often determines their availability to the biota. Exchange rates of zinc are determined for sediment samples from the Newport River estuary, Beaufort, N. C. The coring device for collecting sediments is constructed with a vinyl-stoppered polyethylene cylinder that is detached after the core is taken, to be transported to the laboratory and submerged in water from the sampling station until the concentration of the trace element of interest becomes constant in the water, which is aerated without disturbing the sediment, filtered, and part returned. With the cylinder in a lead shield radioactivity from a narrow wedge of the water column can be periodically measured and amount of exchangeable element calculated. The average rate of exchange for ten cores was $17 \pm 4\ \mu$ of Zn $hr^{-1}m^{-2}$.—GDC

04212 **Durham, David L.** Geologic map of the Adelaida quadrangle, San Luis Obispo County, California: U.S. Geol. Survey Geol. Quad. Map GQ-768, scale 1:24,000, section, 1968.

04120 **Eales, Hugh V.** Determining fineness variation characteristics in gold ores by reflectometry: Econ. Geology, v. 63, no. 6, p. 688–691, illus., tables, 1968.

Determinations of gold content of natural gold–silver particles by reflectometric methods give results for the mean fineness of concentrate samples that correspond closely to those derived from assay or production data. Reflectometry is thus useful in studies of grain-to-grain variations. "With sufficient determinations, a characteristic distribution of the fineness values in certain ores may become apparent."—WSW

04043 **Eaton, Jerry P.** Spatial distribution of aftershocks of the June 27, 1966, Parkfield–Cholame earthquake in the San Andreas fault zone [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 84, 1968.

04326 **Edwards, Kenneth W.** Isotopic analysis of uranium in natural waters by alpha spectrometry: U.S. Geol. Survey Water-Supply Paper 1696-F, p. F1–F26, illus., tables, 1968.

A method is described for the determination of U-234/U-238 activity ratios for uranium present in natural waters. The uranium is coprecipitated from solution with aluminum phosphate, extracted into ethyl acetate, further purified by ion exchange, and finally electroplated on a titanium disc for counting. The individual isotopes are determined by measurement of the alpha-particle energy spectrum using a high resolution low-background alpha spectrometer. Overall chemical recovery of about 90 percent and a counting efficiency of 25 percent allow analyses of water samples containing as little as 0.10 μ g/l of uranium. The accuracy of the method is limited, on most samples, primarily by counting statistics.—Author's abstract

04295 **Eggler, D. H.** Virginia Dale Precambrian ring-dike complex, Colorado–Wyoming: Geol. Soc. America Bull., v. 79, no. 11, p. 1545–1563, illus., tables, geol. map, 1968.

A sub-circular granitic feature about nine miles in diameter, part of a batholith of Sherman Granite, intrudes Precambrian metamorphic rocks. It consists of four main zones: (1) an outer ring-dike of hornblende-biotite granite; (2) a composite zone of metamorphic rocks and diorite, andesite, quartz monzonite, and hybrid rocks, all showing signs of brecciation and mechanical mixing; and (3,4) two core zones of biotite quartz monzonite. Chemical, optical, and computer analyses suggest that the rocks of the ring-dike complex crystallized at higher water pressure than did the surrounding Sherman Granite. Gravity data indicate the core is a dome emplaced along older ring fractures. The outer ring-dike may be a collapse structure fed by tongues or sheetlike intrusions of the Sherman batholith.—EHP

04024 **Ehlig, Perry L.** Causes of distribution of Pelona, Rand, and Orocopia Schists along the San Andreas and Garlock faults, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 294–305, illus.; discussion, p. 305–306, 1968.

Occurrences of Pelona Schist and its correlatives are restricted to a dozen areas distributed along a 270-mi segment of the San Andreas fault and a 75-mi segment of the Garlock. In part, distribution reflects fault displacement, but initially schist occurred along at least 100 mi of San Andreas fault, with the most southerly no less than 150 mi from that along the Garlock. All three schists were derived from similar lithologic assemblages, probably deposited during Mesozoic, perhaps an extension of the eastern Franciscan terrane. Upper Cretaceous(?) metamorphism was probably restricted to sediments deeply buried beneath thrust sheets. Erosional exhuming of schists begun during the Miocene is continuing. Schists appear to have formed in a narrow belt along each fault; the preferred hypothesis is that dilatant movement created troughs and subsequent compressional movement brought about burial.—*from* Author's abstract

04052 **Eisler, Joseph D.** Field investigation of a method for determining stress accumulation at depth in the Gabilan Range near Salinas [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 110, 1968.

Eldredge, Niles. *See* Kay, Marshall. 04443

El-Etr, Hasan A. *See* Proctor, Paul Dean. 04126

04084 **Ellison, A. H.** The Hamill Group of the northern Dogtooth Mountains, British Columbia, Canada [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 205, 1968.

Engel, René. *See* Vali, V. 04364

04205 **Englund, Kenneth J.** Geologic map of the Bramwell quadrangle, West Virginia–Virginia: U.S. Geol. Survey Geol. Quad. Map GQ-745, scale 1:24,000, section, text, 1968.

Low volatile bituminous coal, occurring mainly in the Pocahontas Formation, is the principal developed mineral resource in the Bramwell quadrangle. Resources of potential economic value include limestone, sandstone, siltstone, and shale, which have been used in construction and surfacing of roads. New formation names for the area include: Neal Sandstone Member of Hinton Formation (former Avis Sandstone), Pratter Shale Member of the Hinton (former Falls Mills Shale), and Bramwell Member of the Bluestone Formation (applied to a previously unnamed unit consisting mostly of calcareous siltstone and shale with abundant marine fossils).—MCM

Erd, Richard C. *See* Hewett, D. F. 04221

Erickson, Ralph L. *See* Mudge, Melville R. 04110

04164 **Eriksson, Erik.** Air–ocean–icecap interactions in relation to climatic fluctuations and glaciation cycles, *in* Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 68–92, illus., table, 1968.

Radiation models based on seasonal variation of the Earth's heat balance indicate a stronger dependence of mean temperature on solar radiation than that predicted by the simple black-body model frequently used. Neither changes in the Earth's orbital elements nor carbon-dioxide fluctuations are considered prime causes of glacial cycles. A mathematical model of the dynamics of glaciation establishes functional relationships between amount of ice coverage and planetary mean temperature. Time lag between extremes of glaciation and atmospheric temperature is estimated. The large paleotemperature variations (about 10°C) derived from O-18 analysis of shells in Pleistocene deep-sea sediments may not be valid, as the temperature of the main mass of sea water probably changed very little between glacial and interglacial periods.—*from* Author's abstract

Escalante, G. *See* Krushensky, R. D. 04478

04405 **Esker, George C., 3d.** Designation of a lectotype of *Globotruncana rosetta* (Carsey): Cushman Found. Foram. Research Contr., v. 19, pt. 4, p. 169–171, illus., 1968.

To resolve contradictory statements made by various authors in describing the holotype of *Globotruncana rosetta* (Carsey, 1926, Cretaceous, central Texas), Esker has studied the Carsey collection, but the holotype apparently has been lost. A lectotype is selected from three specimens labelled as cotypes; these are not conspecific, the other two belonging to *G. aegyptiaca* and *G. gansseri*. The lectotype has two keels on all chambers but the final one, the keels becoming more closely spaced in the younger chambers. Esker concludes that double-keeled specimens from the upper Taylor Marl of Texas may be assigned to *G. rosetta*, *G. ventricosa*, and *G. linneiana*; distinctions are made.—VMJ

04406 **Esker, George C., 3d.** A new species of *Pseudoguembelina* from the Upper Cretaceous of Texas: Cushman Found. Foram. Research Contr., v. 19, pt. 4, p. 168–169, illus., 1968.

Pseudoguembelina kempensis, n.sp., has been found in surface and subsurface samples in the Kemp Clay; type locality is near Cameron, Milam County, east-central Texas. It appears to be restricted to the *Globotruncana gansseri* zone and, though rare in the samples, it may prove to be a useful index species for this zone.—VMJ

Evans, E. H. *See* Swanson, H. E. 04358

04222 **Evans, T. L.; Campbell, F. A.; Krouse, H. R.** A reconnaissance study of some western Canadian lead-zinc deposits: Econ. Geology, v. 63, no. 4, p. 349-359, illus., tables, 1968.

Deposits of Mississippi Valley type occur in Cambrian rocks in Alberta and British Columbia near Banff and in Devonian rocks in northern Alberta and British Columbia, as well as adjoining Northwest Territories (Pine Point). The iron content of 20 representative sphalerites, analyzed also for Cd, Mn, and Se, suggest a minimum temperature of formation of about 100°C. In 31 samples, excess S-34 ranged from 8.1 to 31.3 per mil. The sulfur thus is not typically magmatic, and is probably biogenic. Sulfur in earlier formed sulfides is typically heavier than that from later sulfides. Sulfides are believed to form at interface between metal-bearing brine and overlying H_2S-rich natural gas.—WSW

04149 **Eversoll, Duane A.; Burchett, Ray.** Nebraska geology and highway engineering procedures, *in* Highway geology symposium, 17th Ann., Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 54-65, illus., 1968.

A study of the general geology in Nebraska is necessary for use in highway engineering problems. This paper describes in general terms the soils of Recent age and also the older bedrock as encountered either in the surface or subsurface. Problems dealing with these different geological formations are examined in their relation to highway engineering design. Procedures, techniques, and equipment used by the Nebraska Highway Department in obtaining samples and information are discussed.—Authors' abstract

Ewing, Maurice. *See* Donn, William L. 04166

Ewing, Maurice. *See* Worzel, J. Lamar. 04465

04504 **Exum, F. A.; Harms, J. C.** Comparison of marine-bar with valley-fill stratigraphic traps, western Nebraska, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1851-1868, illus., tables, 1968.

These stratigraphic traps in the Cretaceous "J" sandstone illustrate control of reservoir characteristics by depositional environment. The sandstone reservoirs deposited as shallow-marine bars are elliptical lenses; the sandstone grades laterally into marine mudrock. The bars are scattered and their orientation is varied. Entrapment is independent of structural closure and most bar bodies are oil filled. The position of marine-bar reservoirs can be predicted by techniques which map gradients in sandstone-shale proportions. The valley-fill reservoirs are within a long narrow prism of sandstone; the boundaries of the reservoirs are erosional. Oil is trapped only where the valley-fill trend crosses plunging anticlines. These reservoirs cannot be detected by examination of the enclosing facies. Environmental interpretation of these reservoirs is based on fossils, sedimentary structures, textures, facies relations, and geometry.—EAM

04129 **Eyre, S. R.** Vegetation and soils—A world picture (2d edition): Chicago, Ill., Aldine Publishing Co., 328 p., illus., 1968; originally published 1963.

This book is an introduction to the study of world-wide vegetation patterns, their development, and relationships to soil types. It is divided into four parts: Part 1 is devoted to the evolution of plant communities and soil profiles; part 2 covers areas outside the tropics which include coniferous forest regions, mixed and broad-leaved forests of the middle latitudes, alpine and arctic tundras, grasslands, and woodlands and scrublands; part 3 discusses the British Isles; part 4 considers tropical regions with chapters on rain forests, seasonal tropical forests, semi-desert and desert

areas, the savanna, and mountain areas. An extensive bibliography and continental vegetation maps are included.—BSH

04454 **Faccioli, Ezio.** A discrete Eulerian model for spherical wave propagation in compressible media [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 594B–595B, 1968.

Fahey, Joseph J. *See* Reichen, Laura E. 04002

Feltis, R. D. *See* Mower, R. W. 04469

Fergus, John H., Jr. *See* Simpson, Dale R. 04304

04213 **Ferguson, S. A.** (compiler). Renabie Mines Limited, Nudulama Mines Limited, and adjoining properties, surface geology—Parts of Rennie, Leeson, and Brackin townships, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 492, scale 1 in. to 500 feet, text, 1968.

Country rocks in the area consist of metabasalt with an associated group of meta–ash flow rocks which are presumed to overlie the metabasalts. A major area of granitic rocks adjoins the eastern edge of the volcanic rocks and a few granitic dikes cut these same rocks; narrow aplite dikes occur within the granitic rocks. From south to north, the strike is arcuate curving from northwest to northeast. Three main faults in the Renabie mine displace both the quartz veins and the diabase dikes; in this mine average recovery of gold per ton is 0.21 ounces.—MCM

04177 **Fernald, Arthur T.; Corchary, George W.; Williams, William P.** Surficial geologic map of Yucca Flat, Nye and Lincoln Counties, Nevada: U.S. Geol. Survey Misc. Geol. Inv. Map I–550, scale 1:48,000, 1968.

04044 **Filson, John R.; McEvilly, Thomas V.** Love wave spectra and the mechanism of the 1966 Parkfield sequence [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 85; discussion, p. 85–86, 1968.

04004 **Finch, Warren I.** Engineering geology of the Paducah West and Metropolis quadrangles in Kentucky: U.S. Geol. Survey Bull. 1258B, p. B1–B19, illus., tables, geol. map, 1968.

Surficial deposits are widespread in the area and consist chiefly of unconsolidated silt and clay of alluvial, lacustrine, and loessal origin and of underlying poorly consolidated, sandy, clayey gravel. Bedrock formations crop out mainly in creek bottoms and along steep slopes, and consist of poorly to moderately consolidated sand, lean to plastic clay, and mixtures of sand, clay, and silt. On the basis of laboratory and field tests, the general engineering properties and behavior are given for the various surficial and bedrock materials. Problems of flooding and earthquakes are discussed. Assessment is made on the availability of construction materials.—*from* Author's abstract

04452 **Finlayson, James Bruce.** A chemical study of Hawaiian volcanic gases [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 507B, 1968.

04308 **Fishman, Marvin J.; Midgett, Maryland R.** Extraction techniques for the determination of cobalt, nickel, and lead in fresh water by atomic absorption, [Chap.] 12 *in* Trace inorganics in water—Am.Chem.Soc., 153d Ann.Mtg., Miami Beach, 1967, Div. Water, Air and Waste Chemistry Symposium: Washington, D.C., Am.Chem.Soc.(Adv.Chemistry Ser.73), p. 230–235, tables, 1968.

The detection limits for cobalt, nickel, and lead in aqueous solution by atomic absorption are about 50 μg per liter. Normally these elements occur at lower concentrations in fresh waters, and direct measurement by atomic absorption is not possible. A rapid, simple, accurate, and sensitive chelation–extraction method for determining lead, cobalt, and nickel is attained by chelating the metals with ammonium pyrolidine dithiocarbamate at a pH of 2.8, extracting the metal–chelates with methyl isobutyl ketone, and aspirating the ketone layer. Results agreed well

with those obtained by spectrographic methods. As little as 1 μg of lead, cobalt, and nickel per liter can be detected, at least one order of magnitude lower than most other wet chemical procedures.—*from* Authors' abstract

Fleischer, Michael. *See* Parker, Raymond L. 04103

Fleming, S. J. *See* Aitken, M. J. 03971

04165 **Fletcher, J. O.** The influence of the Arctic pack ice on climate, *in* Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 93–99, illus., 1968.

An assessment is made of each component of the heat budgets of the surface and of the earth–atmosphere system in the central Arctic, both for an ice-covered ocean and for an ice-free ocean. The annual patterns of atmospheric heat loss for both conditions are obtained as residuals; the relation of these patterns to general atmospheric circulation and glacier accumulation is discussed. It is shown that atmospheric cooling in the Arctic is closely related to certain indices of atmospheric circulation. An ice-free Arctic Ocean would probably be associated with atmospheric circulation more vigorous in summer at subarctic latitudes and of comparable vigor in winter. The cool summers and warm, moist winters would be highly conducive to glacier growth.—Author's abstract

04381 **Flower, Rosseau H.** Silurian cephalopods of James Bay lowland, with a revision of the family Narthecoceratidae [with French abs.]: Canada Geol. Survey Bull. 164, 88 p., illus., 1968.

Cephalopod faunules were found in six horizons in the Severn River and Ekwan River Formations. Of 25 species described, 18 are new, 4 are new but unnamed, and 3 have been previously described. All belong to the *Discosorus–Huronia* faunas, and are in beds regarded as early Clinton in age. New material contributes to the solution of two systematic problems: (1) *Humeoceras* is a piloceroid, morphologically very close to *Piloceras s.s.*; it is the only post-Canadian member of the Piloceratidae known. (2) The family Narthecoceratidae belongs to Michelinoceratida, not to Endoceratida as formerly thought, and developed from the family Troedssonellidae; the family is revised, and Ordovician forms, mainly belonging to *Narthecoceras* are described. Here also are placed *Donacoceras*, *Tasmanoceras*, and the new genus *Farroceras*.—*from* Author's abstract

Folinsbee, R. E. *See* Chrismas, L. 04138

Folk, Stewart H. *See* Salas, Guillermo P. 04147

04280 **Foose, Richard M.; Rytuba, James J.; Sheridan, Michael F.** Volcanic plugs in the Connecticut Valley Triassic near Mt. Tom, Massachusetts: Geol. Soc. America Bull., v. 79, no. 11, p. 1655–1661, illus., tables, 1968.

A number of basaltic volcanic plugs are well exposed on the east flank of the Mt. Tom Range near Holyoke, Mass. Flows, breccias, tuffs, sills, and dikes are associated with these centers and are partially interbedded with the Longmeadow Sandstone (Triassic) about 200 feet above the massive Holyoke basalt sheet. The thickness, areal coverage, and direction of movement of five flows associated with the Mt. Tom plug have been mapped. Individual flows from this volcanic center are of two types: those containing 65 to 75 percent chlorophaeite, and those having felty texture with negligible original "glass". Direction of movement of the flows was determined by plotting the preferred orientation of the (010) plane of feldspars. The complete geologic history of the Mt. Tom plug is presented in a series of sequential maps and sections.—Authors' abstract

Footen, Joseph J. *See* Holmes, Robert F. 04183

04112 **Fox, Kenneth F., Jr.; Rinehart, C. Dean.** Geology of magnesite deposits in northern Okanogan County, Washington—A preliminary report: U.S. Geol. Survey Bull. 1272-B, p. B1–B15, tables, geol. map, 1968.

Magnesite-bearing rock crops out as irregularly-shaped lenses ranging in maximum thickness from 5–50 feet and in outcrop length from 100–1,000 feet within a narrow stratigraphic zone at the base of the Kobau Group, a Triassic(?) eugeosynclinal sequence of greenstone and metachert at its unconformable contact with the subjacent Anarchist Series, a weakly metamorphosed sequence of Permian chert-conglomerate, graywacke, siltstone, and limestone. Magnesitic rock consists of varying proportions of magnesite, quartz, and dolomite; its magnesia content ranges from about 22–34 percent. Several deposits have been located within the 23-mi span of the contact so far reconnoitered, and existence of additional deposits is likely. Deposits are probably sedimentary, although the magnesite is now recrystallized and perhaps locally is hydrothermally redistributed within the zone.—*from* Authors' abstract

04492 **Fox, P. J.; Heezen, Bruce C.; Harian, A. M.** Abyssal anti-dunes: Nature, v. 220, no. 5166, p. 470–472, illus., 1968.

In the Lower Continental Rise Hill province of the Atlantic Ocean, the oblique orientation of the hills in the direction of current flow and truncation of beds on the down-current flank of the individual hills indicate that the hills have migrated up-current and up-slope through time. Movement of this type is observed in the beds of high velocity streams, where anti-dunes of sand-sized material migrate upstream. So little is known about the behavior of clay and silt during deposition in the deep-sea environment that the hydrodynamic and sedimentary regime that could produce up-current migration in the abyss is obscure. There is evidence that a more uniform deposition may be characteristic of the hill province at present, that migration may have temporarily ceased, and that the growth of the abyssal plains in the recent past has exceeded rates of hill formation.—DBV

04450 **Frankenberg, Julian Myron.** Structure and development of the underground parts of arborescent lycopsida from the Pennsylvanian of North America [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 496B–497B, 1968.

04483 **French, Robert R.** Crushed stone resources of the Devonian and Silurian carbonate rocks of Indiana: Indiana Geol. Survey Bull. 37, 127 p., illus., tables, 1968.

The purpose of this report is to bring together the stratigraphic, petrographic, chemical, physical, and economic data compiled in published or unpublished form that are pertinent to the crushed stone industry of northern and eastern Indiana. Information available in 1964 concerning the occurrence, thickness, and chemical and physical characteristics of exposed or shallow Devonian and Silurian strata in Indiana is compiled in tabular form.—KAF

04359 **Frey, Fred A.; Haskin, Mary A.; Poetz, Jo Ann; Haskin, Larry A.** Rare earth abundances in some basic rocks: Jour. Geophys. Research, v. 73, no. 18, p. 6085–6098, illus., tables, 1968.

Rare-earth (RE) abundances are reported for several basalts, diabases, and gabbros. Compared with the RE distribution in chondritic meteorites, continental basic rocks are characterized by an enrichment of the light lanthanides. Intrusive basic rocks have lower RE contents and less fractionated RE distributions than continental basalts. Oceanic island basalts have RE abundances similar to those of continental basalts. Abyssal subalkaline basalts dredged from the mid-Atlantic ridge and Eastern Pacific rise have RE distributions which are nearly chondritic. There is a depletion in La, Ce, Pr, and a broad maximum from Sm to Tb. Similar patterns are found in fresh basalts, slightly altered basalts, and in greenstones. Abyssal basalts that are more alkalic are not depleted in La, Ce, and Pr. The relation of the RE data to hypotheses for the origin of ridge basalts is considered.—*from* Authors' abstract

Friedel, R. A. *See* Retcofsky, H. L. 04490

Friedman, Gerald M. *See* Blee, John J. 04400

04152 **Fritz, Axel M.** Engineering geophysics—Its use and abuse, *in* Highway geology symposium, 17th Ann., Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 84–91, 1968.

This is an exhortation for the use of refraction seismic and electrical resistivity methods in engineering geophysics. It is important that the engineer and geologist know how to use these techniques as well as understand their limitations. A few of the troublesome areas of knowledge and misconceptions about the devices are discussed, as are suggestions for the prevention of mistakes. Electrical resistivity is the more common and useful of the two, and the principles behind the instruments are outlined. Some of the more modern portable seismic devices are discussed also.—HRC

Fritz, P. *See* Chrismas, L. 04138

03978 **Frye, J. C.; Leonard, A. B.** Late-Pleistocene Lake Lomax in western Texas [with French and Spanish abs.], *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 519–534, illus., 1968.

The lacustrine deposits consist predominantly of fine to medium sand and granular gypsum, with some silt and very little clay, and attain a maximum elevation of 2,510 feet. The deposits underlie extensive lake plains at two levels and beach ridges and bars; distinctive early Wisconsinan mollusks are in the upper part of the deposits. The basin was formed by solution-subsidence accompanied by eolian deflation of weak Tertiary Ogallala sediments. The subsidences interrupted drainage and caused the abandonment of Panther Valley, and probably began in Kansan time and continued into Wisconsinan. The lake was captured through a col west of Big Spring. An interval of dessication and very low lake level is indicated following the Kansan pluvial, during Yarmouthian, Illinoian, and Sangamonian time, and again following the pluvial of early and perhaps middle Wisconsinan.—*from* Authors' abstract

Fullagar, Paul D. *See* Bottino, Michael L. 04497

Gaca, J. R. *See* Peterson, D. L. 04408

Gadsby, J. W. *See* Hoy, E. M. 04251

04418 **Gaede, Verne F.; Rothermel, R. V.; Axtell, L. H.** Brea-Olinda oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1967, v. 53, no. 2, pt. 2, p. 5–24, illus., tables, 1968.

Brea-Olinda field is in the northeastern part of the Los Angeles basin, adjacent to and within the Whittier fault zone; to the southwest the principal structural feature is the La Habra syncline, the northwest-trending axis of which is roughly parallel to the fault zone. The most important oil accumulation lies in the block south of the Frontal fault, the southernmost fault of the Whittier zone. Sediments ranging in age from middle Miocene through Recent are present. Pliocene producing zones are in the lower Fernando Formation; Miocene zones in the Sycamore Canyon Member of the upper Puente Formation, have produced a substantial majority of the oil and gas.—MCM

04113 **Gair, Jacob E.; Thaden, Robert E.** Geology of the Marquette and Sands quadrangles, Marquette County, Michigan: U.S. Geol. Survey Prof. Paper 397, 77 p., illus., tables, geol. maps, 1968.

Deformed and metamorphosed middle Precambrian metasedimentary rocks rest unconformably on lower Precambrian gneiss and metavolcanic greenstone at the east end of the Marquette synclinorium and iron range. Dikes of middle Precambrian or older metadiabase and upper Precambrian diabase and small quartz veins are common. Some diabase dikes have negative magnetic polarization. Syenite dikes and a plug of serpentinized peridotite intrude the gneiss. Flat-lying Cambrian(?) sandstone truncates older rocks at and near the shoreline of Lake Superior. Secondary concentrations of iron in fracture and shear zones are

widespread but have no economic potential. Small concentrations of copper are present near the bottom of the lower middle Precambrian Kona Dolomite. Algal structures occur widely in the dolomite; the dolomite locally has been completely silicified.—JEG

04270 **Galle, O. Karmie.** Routine determination of major constituents in geologic samples by atomic absorption: Appl. Spectroscopy, v. 22, no. 5, p. 404–408, illus., tables, 1968.

To determine Al_2O_3, Fe_2O_3, TiO_2, MnO, CaO, and MgO in standard samples 1–A, G–1, W–1, BRC–1, and PCC–1, a 0.5 to 1.0 g sample is put into solution by treatment with HF, followed by fusion of the HF residue with $K_2S_2O_7$ and solution of the fused material with HCl. Determination of the elements is then made using an acetylene–nitrous oxide flame and a premix type burner. This method eliminates changing flame parameters because of the refractory and nonrefractory elements. Results obtained agree within 0.1 percent or less of listed values. Standard deviations and coefficients of variation were also calculated for all elements determined on each sample and found to be within acceptable limits.—*from* Author's abstract

04397 **Gambell, Neil.** Analysis of heavy mineral concentrates, Yavapai County, Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 6–27, 1968.

04059 **Gard, Leonard M., Jr.** Geologic studies, Project Gnome, Eddy County, New Mexico: U.S. Geol. Survey Prof. Paper 589, 33 p., illus., tables, 1968.

The Geological Survey provided preshot and postshot geologic, geophysical, and hydrologic information for Project Gnome, a Plowshare Program underground nuclear detonation in salt near Carlsbad, N. Mex. The mining of a 1,200-ft shaft and 1,000-ft drift provided an opportunity to study the evaporite and clastic rocks of the Permian Salado and Rustler Formations and Dewey Lake Redbeds and the Pleistocene(?) Gatuna Formation, as well as the surficial alluvial and eolian sands. Underground mapping and logging disclosed the cyclical nature of the evaporite deposits. The explosion produced a cavity 70 feet high and 150 feet across. Postshot investigations revealed that geologic phenomena resulting from the explosion included intrusive breccia veins associated with complex thrust faulting and the formation of the minerals laurionite and galena.—LMG

04446 **Gardner, Robert Alexander.** Sequence of podzolic soils along the coast of northern California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 445B–446B, 1968.

Garrels, Robert M. *See* Helgeson, Harold C. 04125

04233 **Garrett, Robert G.** Trend surface analysis of trace chemical data, Park City district, Utah [discussion of 1967 paper by M. P. Nackowski and others]: Econ. Geology, v. 63, no. 4, p. 423–425, illus., table, 1968.

Trend surface analyses performed on the Park City data have doubtful meaning (1) because the data used probably have a bimodal or even trimodal distribution, and (2) because a logarithmic transformation should have been applied to those data that show lognormal distribution.—WSW

04536 **Garrison, Louis Eldred.** Cretaceous–Cenozoic development of the continental shelf south of New England [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 658B, 1968.

Garside, Larry J. *See* Schilling, John H. 04181

04020 **Gastil, R. Gordon.** Fault systems in northern Baja California and their relation to the origin of the Gulf of California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 283–286, illus., 1968.

Continental borderland faults, a northwesterly-trending system, lie largely offshore between the Los Angeles basin and the Vizcaino Peninsula. Seismic events suggest

continued activity. Conjugate rifts, a system of northwesterly- and northeasterly-trending faults, respectively right- and left-lateral, crisscross the peninsula as far south as the Sierra de San Pedro Martir. There is evidence of recent movement. Gulf depression faults, a web predominantly northwest-trend, that cover the peninsula east of the topographic crest, form tilted blocks mostly upthrown along the western edge; few show any lateral slip. They originated with Miocene volcanic eruptions accompanying formation of the Gulf of California depression, which was still occupied by a landmass in the early Tertiary. Since the San Andreas was moving in the Cretaceous, and is still moving, it seems unlikely that there is a causal relationship; the depression is viewed as part of the Basin and Range province.—ESL

04054 **Gastil, R. Gordon.** How good is the evidence for 450 miles of offset on the San Andreas fault?, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 208–211, illus., 1968.

The paper, prepared after the conference at the invitation of the editor, examines the evidence for, and problems raised by, the larger offset. The only existing argument for more than 160 miles of slip along the San Andreas fault is the anomalous position of the Salinian block; yet to account adequately for the position of this block by strike slip, it is apparently necessary to seek evidence for a left-lateral fault with 450 miles of slip to the west of the block, and an additional right-lateral fault with 300 miles of slip on the east. Perhaps alternative explanations for the position of the Salinian block should be sought instead.—ESL

04455 **Gates, Richard Holt.** Inelastic analysis of slopes by the finite element method [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 595B, 1968.

Geiss, J. *See* Balsiger, H. 04524

Gilbert, Freeman. *See* Backus, George. 04288

04209 **Gildersleeve, Benjamin.** Geologic map of the Bee Spring quadrangle, Edmonson and Grayson Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-757, scale 1:24,000, section, text, 1968.

Resources mined in the Bee Spring quadrangle are limestone from the Glen Dean, rock asphalt in the basal part of the Caseyville Formation, and coal from the Tradewater and Caseyville Formations.—MCM

04154 **Giles, David L.; Thompson, Tommy B.** Petrologic aspects of a molybdenum-bearing alkalic stock, Sierra Blanca, south central New Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 699, 1968.

04137 **Giletti, B. J.; Yund, R. A.; Lin, T. H.** Sulfur vapor pressure of pyrite–pyrrhotite [abs.]: Econ. Geology, v. 63, no. 6, p. 702, 1968.

04537 **Glass, Billy Price.** Correlation of Pliocene and Pleistocene events in deep-sea sediments by geomagnetic reversals [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 658B–659B, 1968.

Godfrey, Andrew E. *See* Bricker, Owen P. 04307

04429 **Golik, Abraham.** History of Holocene transgression in the Gulf of Panama: Jour. Geology, v. 76, no. 5, p. 497–507, illus., tables, 1968.

Thin foraminiferal sediments of radiocarbon-dated Holocene age record, first, shallow-water sand and mud deposition in the Gulf when sea level was 50 m lower than now. Subsequent rapid rise of the sea caused abrupt changes in lithology and fauna. During the rise, supply of terrigenous sediment was reduced as the shoreline migrated landward—only sand formed in situ was deposited. After sea level stabilized at nearly its present height, terrigenous mud spread outward over the sand. At the seaward edge of the mud lens, 6,500 years have elapsed between deposition of the sand and of the overlying mud.—DRM

04115 **Gómez, Manuel; Pickard, Greenleaf W.; Coolbaugh, David F.** Geochemical ore guides at Charcas unit, San Luis Potosí, Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 703, 1968.

04309 **Goodman, J. V.** Underground gas storage in oil and gas reservoirs, *in* Natural gases of North America—Pt. 4, Papers of general scope: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1865–1889, illus., tables, 1968.

The first successful venture in underground storage was in Ontario in 1915; the first in the United States was at Buffalo, New York, in 1916. Acceleration began and continues. The reservoirs may be mined-out areas of coal, salt, or other minerals. Depleted oil and gas reservoirs are the most generally used storage areas, although increasing use is being made of underground structural traps which have not yielded oil or gas. All types of traps are used in rocks of all geologic ages and in rocks with many types of reservoir characteristics. The primary requisite is—there must be a trap; porosity and permeability are also important factors.—*from* Author's abstract

04184 **Gopalan, K.; Wetherill, G. W.** Rubidium–strontium age of hypersthene (L) chondrites: Jour. Geophys. Research, v. 73, no. 22, p. 7133–7136, illus., table, 1968.

Five normal gray hypersthene chondrite falls were analyzed for Rb, Sr, and Sr isotopic composition. One has such low Rb/Sr and Sr-87/Sr-86 ratios that it, in conjunction with others, permits determination of an isochron for L-chondrites alone, without resort to the data of any other types of meteorite and attendant assumptions of cogenesis. An age of $4.48 \pm 0.14 \times 10^9$ years ($\gamma = 1.39 \times 10^{-11}$ per year) and initial Sr-87/Sr-86 ratio of 0.7008+.001 were measured. Blank corrections were less than 0.2 and 0.1 percent for Rb and Sr, respectively, in processing about 300 mg of sample.—Authors' abstract

04413 **Gordon, Joan E.; O'Brien, Kathryn G.; Langenheim, R. L., Jr.** Devonian stratigraphy and biostratigraphy at Dutch John Mountain, Lincoln County, Nevada: Illinois Acad. Sci. Trans., v. 61, no. 3, p. 233–246, illus., 1968.

The Devonian sequence at Dutch John Mountain includes the Silverhorn Dolomite (Lower Dolomite and Limestone Member, 1217 feet; Middle Limestone and Dolomite Member, 470 feet; and Upper Dolomite Member, 778 feet); West Range Limestone, 245 feet; and the Lower Member of the Pilot Shale, 122 feet. Conodonts and other invertebrate fossils indicate that the Silverhorn Dolomite ranges from the latest Givetian through the earliest Fammenian, and that the West Range Limestone is entirely Fammenian as well as the Lower Member of the Pilot Shale. The base of the sequence is covered and the Lower Member of the Pilot Shale is disconformably succeeded by the Joana Limestone of Mississippian age.—Authors' abstract

04085 **Gorveatt, A. C.** Permo-Pennsylvanian spiriferids from the Yukon Territory [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 205–206, 1968.

03996 **Gott, Garland B.; Zablocki, Charles J.** Geochemical and geophysical anomalies in the western part of the Sheep Creek Range, Lander County, Nevada: U.S. Geol. Survey Circ. 595, 17 p., illus., table, 1968.

Extensive geochemical anomalies are present along the west side of the Sheep Creek Range in Lander County, Nev. Anomalous concentrations of zinc, arsenic, mercury, silver, copper, lead, and to some extent gold, molybdenum, and antimony occur in iron-rich material along fracture planes and in quartz veins in Paleozoic formations. A magnetic anomaly occurs over a pediment at the southern part of the range, close to one of the geochemical anomalies. Gravity and electrical resistivity measurements suggest that the magnetic anomaly is caused by an intrusive igneous mass rather than by a block of downfaulted basalt. A limited amount of shallow drilling would clarify the geochemical and geophysical data.—Authors' abstract

Gotthardt, B. *See* Degens, E. T. 04440

04339 **Grant, Raymond W.** Mineral collecting in Vermont: Vermont Geol. Survey Spec. Pub. 2, 49 p., illus., tables, 1968.

Vermont has attracted very few mineral collectors, and this publication is intended to aid the amateur collector. The geology of the State and types of mineral occurrences are reviewed briefly, and 42 known localities are described by counties. Localities were chosen to illustrate as many different geologic types as possible, to be widely distributed, and to contain as many different minerals as possible. A geologic and a metamorphic sketch map, and a mineral index are included.—ESL

Grantz, Arthur. *See* Stanford Univ. School Earth Sci. 03956

04298 **Green, John Chandler.** Geology of the Connecticut Lakes–Parmachenee area, New Hampshire and Maine: Geol. Soc. America Bull., v. 79, no. 11, p. 1601–1638, illus., tables, geol. map, 1968.

On the northwest flank of the Boundary Mountains anticlinorium or the southeast flank of the Connecticut Valley–Gaspé synclinorium is a section of about 23,000 feet of Ordovician and some Cambrian strata that were folded, metamorphosed and intruded by granodiorite during the Taconic orogeny. A thin discontinuous layer of Upper Silurian limestone is exposed along the Taconic unconformity. A thickness of 20,000 feet of Devonian, the Seboomook and Frontenac Formations, lies to the northwest. These rocks were folded and metamorphosed during the Acadian orogeny, which also affected the older rocks and was accompanied by granitic intrusion.—AH

Griffith, Lawrence S. *See* McCamis, John G. 04507

Griffitts, W. R. *See* Hawley, C. C. 03998

Groegler, N. *See* Balsiger, H. 04524

03955 **Grögler, Norbert.** Classified bibliographies, *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 645–662, 1968.

Bibliographies on thermoluminescence, assembled from data on file at the Physikalisches Institut [Switzerland], include a number of North American references. The material has been divided into several sections: geology and mineralogy; age determination; climate and paleotemperatures; age determinations on ceramics; meteorites; rocket and satellite experiments; and bibliographies. No attempt has been made to cover the very extensive literature on medical thermoluminescence dosimetry.—GDC

Grossman, J. J. *See* Ryan, J. A. 04487

04139 **Guilbert, John M.; Lowell, J. David.** Potassic alteration in porphyry copper deposits [abs.]: Econ. Geology, v. 63, no. 6, p. 703, 1968.

Guillard, R. R. L. *See* Degens, E. T. 04439

Hackett, J. E. *See* Kempton, J. P. 03979

Haffty, Joseph. *See* Rye, Robert O. 04116

04527 **Hall, John W.; Swanson, Nancy Peake.** Studies on fossil *Azolla*—*Azolla montana*, a Cretaceous megaspore with many small floats: Am. Jour. Botany, v. 55, no. 9, p. 1055–1061, illus., table, 1968.

Azolla montana is a new species from the late Cretaceous; it has a megaspore apparatus with a single large and conspicuous columella which resembles the floats of the megaspore apparatus of many extant species. The columella differs from true floats in being pilose, like the perispore of the megaspore body. The 10–20 small true floats are appressed to the columella, and are difficult to distinguish from it. It is suggested that the floats were derived, phyletically, by segmentation of

the columella; the columella represents the primitive "float" of the megaspore apparatus.—Authors' abstract

04122 **Hall, Wayne E.; Heyl, Allen V.** Distribution of minor elements in ore and host rock, Illinois–Kentucky fluorite district and Upper Mississippi Valley zinc–lead district: Econ. Geology, v. 63, no. 6, p. 655–670, illus., tables, 1968.

Minerals of ore and gangue show large differences in minor-element content between districts, and within districts and individual paragenetic sequences. Ore from the fluorite district is characterized by greatest abundance of minor elements, large fractionation of Ag between galena and sphalerite, and low Sb/Ag in galena. Sb and Ag, concentrated in galena, show marked district zonal pattern. Sphalerite is high in Cd, Ga, and Ge. In the Upper Mississippi district, minor elements are less abundant and Ag concentrated in sphalerite. "It is concluded that the minor elements were largely leached from the basement by convective circulation of heated oilfield brine."—WSW

Halladay, I. A. R. *See* Hawryszko, J. W. 04079

04561 **Hamilton, Eric I.** Prikladnaya geokhronologiya, s glavoy sravitel'noy geokhimii L. Kh. Arensa: Leningrad, Izdatel'stvo "Mir," 256 p., illus., tables, 1968.

This is a Russian translation of Hamilton's handbook on absolute age determinations (1965) with an additional introductory chapter by Ahrens entitled "Comparative geochemistry of potassium, rubidium, calcium, argon, strontium, uranium, thorium, and lead."—DBV

04343 **Hamilton, J. B.** Barite occurrences in New Brunswick: New Brunswick Dept. Nat. Resources Mineral Resources Br. Rept. Inv. 5, 23 p., illus., tables, 1968.

Barite has been reported from a number of localities in New Brunswick; occurrences include vein and replacement type deposits, but bedded and residual are not known. Veins are commonly not more than a few inches thick. Mapping and drilling of the largest vein, at Memramcook East, where barite is associated with fluorite, quartz, and minor base metals, has outlined about 50,000 tons. Although only small quantities have been located at Upper Dorchester, this area holds the greatest promise as future prospecting ground. Geological conditions appear similar to those at Walton and Lake Ainslie, Nova Scotia, where significant deposits occur. Gravity surveys over the Dorchester fault might confirm the presence of barite in this area.—*from* Author's abstract

04170 **Hamilton, Warren.** Cenozoic climatic change and its cause, *in* Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 128–133, illus., 1968.

Climatic trends have been broadly parallel and synchronous about the world since late Miocene. Temperate zones extended far poleward of their present limits during the Miocene, and Northern Hemisphere climates were much more equable than now. Late Tertiary deterioration of climates probably was caused primarily by increasing altitudes of continents, and Quaternary glaciation began when these changes crossed a climatic threshold. Quaternary "glacial–interglacial" alternations may be due to rather small variations in insolation, back and forth across the threshold limits. Late Miocene and younger paleotropical indicators are distributed with latitudinal symmetry, but divergencies from symmetry become progressively greater through Mesozoic and Paleozoic time. Continental drift provides the best explanation for this asymmetry.—*from* Author's abstract

04027 **Hamilton, Warren B.; Myers, W. Bradley.** Cenozoic tectonic relationships between the western United States and the Pacific basin, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 342–357, illus., 1968.

One controlling motion in the complex Cenozoic deformation has been a westward shift of the Sierra Nevada and Klamath Mts. Tensional fragmentation behind this mass formed the Basin and Range province whose crust was augmented by

concurrent volcanism. A second motion consists of the northwestward shift of Baja California and coastal California. The actively spreading East Pacific Rise goes under the continent in the Gulf of California and is stepped back into the ocean basin by the Mendocino transform fault. Movement of the Sierra–Klamath block is attributed to spreading of the Rise. The San Andreas is oblique to both Rise and transform faults and is part of the circum-Pacific strike-slip system. A gradual Cenozoic shift of the pole from a point in Alaska toward its present position may have caused sliding of uncoupled continental fragments counterclockwise.—*from* Authors' abstract

Han, Mark C. *See* Ralph, Elizabeth K. 03972

04072 **Handfield, R. C.** Sekwi Formation, a new Lower Cambrian formation in the southern Mackenzie Mountains, District of Mackenzie (95 L, 105 I, 105 P): Canada Geol. Survey Paper 68–47, 23 p., illus., table, 1968.

The name Sekwi Formation is proposed for a distinct fossiliferous carbonate unit of Early Cambrian age that outcrops in a northwest-trending belt, 160 mi by 60 mi, near the boundary between Mackenzie and Selwyn Mountains. At the type section in the Sekwi Range, it consists of 2,525 feet of orange and grey weathering limestone, dolostone and sandy dolostone. Argillaceous sandstone, at least partly Early Cambrian, conformably underlies the Sekwi Formation which is disconformably overlain in places by late Middle Cambrian calcareous shale and in other places by Upper Cambrian limestone. Eastward the Sekwi changes facies to sandstone whereas southwestward it apparently changes to argillite and shale. Early Cambrian fossils found in the Sekwi include aff. *Fallotaspis* sp., aff. *Holmia* sp., *Olenellus* sp., and abundant Archaeocyatha.—*from* Author's abstract

04031 **Hanna, William F.** Aeromagnetic and gravity reconnaissance over the central part of the San Andreas fault [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 214–215, 1968.

Hansen, W. M. *See* Ryan, J. A. 04487

Hanway, J. J. *See* Tabatabai, M. A. 04190

04421 **Hardoin, John L.** Northwest Lost Hills oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1967, v. 53, no. 2, pt. 2, p. 43–48, illus., tables, 1968.

Approximately 7,800 feet of sedimentary rock, predominantly shale, has been penetrated in the Northwest Lost Hills field in Kern County. Stratigraphic units encountered range in age from lower Miocene to Holocene, with the depositional sequence interrupted by two unconformities; all formations are represented except the San Joaquin. The field is on the northwest extension of the asymmetrical Lost Hills anticline, with maximum dips of 30° on the southwest flank and 50° on the northeast flank. Producing zones are the Pliocene Etchegoin and the upper Miocene Antelope Shale.—MCM

Harian, A. M. *See* Fox, P. J. 04492

Harms, J. C. *See* Exum, F. A. 04504

04399 **Harris, I. McK.; Schenk, P. E.** A study of sedimentary structures in the Goldenville Formation, eastern Nova Scotia—Progress report: Maritime Sediments, v. 4, no. 1, p. 1–3, illus., 1968.

This basal part of the lower Paleozoic Meguma Group outcrops on southern coastal islands and headlands of eastern Novia Scotia, at least 18,000 feet of quartzite, greywacke and chloritic slate. Alignments parallel to the northeast-striking regional structure, and paleocurrent trends, facilitate correlation of sedimentological data. The Group has a eugeosynclinal, flysch aspect, with sedimentary features common to turbidity-current deposition. The upward transition of the arenaceous Goldenville, into the euxinic, argillaceous Halifax Formation is in reverse of usual

flysch succession. Detailed work at Taylor Head showed grading in finer strata that was rare in coarser-grained layers, arenite layers with compound stratification, and sedimentary structures masked by cleavage, metamorphism, and fusing of quartz grains. *Astropolithon hindii*, suggestive of "worm mounds", is commonly associated with burrows.—GDC

Harrison, C. G. A. *See* Luyendyk, Bruce P. 04368

Hart, S. R. *See* Davis, G. L. 04522

Haskin, Larry A. *See* Frey, Fred A. 04359

Haskin, Mary A. *See* Frey, Fred A. 04359

03998 **Hawley, C. C.; Griffitts, W. R.** Distribution of beryllium, tin, and tungsten in the Lake George area, Colorado: U.S. Geol. Survey Circ. 597, 18 p., illus., tables, 1968.

Complex ore deposits are spatially associated with granitic bodies of Precambrian age in the Lake George area, Colo. They include greisens that contain high concentrations of beryllium and subordinate amounts of tin, tungsten, and other metals associated with the Redskin Granite. Scheelite deposits in calc-silicate rocks and greisen deposits near Tappan Mountain that contain tin and tungsten minerals are associated with the Silver Plume(?) Granite. Samples of stream sediments and soils locally show anomalous concentrations of beryllium, tin, copper, lead, and molybdenum. Some of the areas of anomalous concentrations correlate with known deposits; others do not, and this fact suggests that further prospecting is warranted.—Authors' abstract

04079 **Hawryszko, J. W.; Halladay, I. A. R.** The Stratigraphic Nomenclature Committee of the Alberta Society of Petroleum Geologists: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 200-202, 1968.

The Committee is composed of five members, four of whom are chosen from the oil industry, and the other from the general profession. The method of review of papers which come before the committee is outlined. Before a paper containing a new name of formational rank or higher is approved for publication, the paper must fulfill certain requirements. It must contain (a) an adequately described section, (b) evidence of mappability, and (c) knowledge of the lateral and vertical variations of the unit. By these stringent rules the committee hopes to forestall many nomenclature problems which have arisen from inadequate presentation of data. It is hoped that authors will keep these criteria in mind when publishing additions or amendments to the stratigraphic nomenclature of the Western Canada Sedimentary Basin.—MST

03980 **Haynes, C. V., Jr.** Geochronology of late-Quaternary alluvium, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 591-631, illus., tables, 1968.

New alluvial chronology studies in the southwestern United States require that the older chronology be altered. The earliest unit (A) lacks positive evidence of Man and is determined by an eroded paleosol. The next overlying unit (B) contains mammoth bones and Clovis artifacts in the lower part and younger paleo-Indian artifacts and bison and camel bones in the upper part, both overlain by a paleosol. Unit (C), the "altithermal" arroyo, contains archaic hunter-gatherer artifacts and is overlain by a paleosol. Unit (D), a mixture of floodplain and slope wash alluvium, contains a modern fauna and pre-ceramic artifacts in the lower part and early ceramic material in the upper. Unit (E) contains late ceramic materials and forms valley floors prior to modern arroyo cutting. At least 100 C-14 dates show that these are time-stratigraphic units.—*from* Author's abstract

Healy, J. *See* Springer, D. 04372

04377 **Heaslip, William Graham.** Cenozoic evolution of the alticostate venericards in Gulf and east coastal North America: Palaeontographica Americana, v. 6, no. 39, p. 55–135, illus., 1968.

Species of heterodont pelecypods formerly lumped under the form taxon *Venericardia alticostata* (Conrad) belong to four subgenera: *Baluchicardia* Rutch and Schenck, 1944: *Rotundicardia*, n. subgen.; *Claibornicardia* Stenzel and Kraus, 1957; *Glyptoactis* Stewart, 1930. The lineage of the group is traced from early Paleocene through their extinction in this region at the end of the Miocene. Their evolution is characterized by several important trends in dentition, shape, and ornamentation, but basic morphological unity is maintained from earliest to latest members. From the primitive baluchicards, the group underwent bursts of adaptive radiation in early Paleocene, middle Eocene, and early Miocene, during which the rotundicards, claibornicards, and glyptoactids successively evolved. Sexual dimorphism developed in the rotundicards and claibornicards. Of the 34 species described, six are new.—VMJ

Heezen, Bruce C. *See* Fox, P. J. 04492

Held, Andrew M. *See* Woodriff, Ray. 04271

04125 **Helgeson, Harold C.; Garrels, Robert M.** Hydrothermal transport and deposition of gold: Econ. Geology, v. 63, no. 6, p. 622–635, illus., tables, 1968.

Geologic characteristics of gold–pyrite–quartz veins, particularly typical gold:quartz ratios, suggest that the veins can be formed from acid solutions containing 0.001–0.05 ppm Au. Thermodynamic calculations indicate that sufficient gold can be carried as chloride complexes in concentrated chloride solutions to account for deposits precipitated above 175°C. Gold, pyrite, and quartz precipitate with falling temperature, gold and pyrite with increase in pH and(or) decrease in oxidation state. Data from fluid inclusions; paragenesis and ratios of gold, pyrite, and quartz; and possibly aluminum content of quartz are potential ore guides.—WSW

Hellebust, J. A. *See* Degens, E. T. 04439

04321 **Helm, D. C.** Records of wells, water levels, and chemical quality of water in the lower Santiam River basin, middle Willamette Valley, Oregon: Oregon State Engineer Ground Water Rept. 13, 186 p., illus., tables, 1968.

Basic water data on the lower Santiam River basin is preliminary to a comprehensive hydrologic study of this productive and intensely irrigated area where expanding population and industry increases the demand for water. Highest yielding wells are in shallow alluvial aquifers near the main streams; yields range from several hundred to more than a thousand gpm. Wells in lacustrine and older alluvial aquifers that underlie low, flat terraces have yields from a few tens to a few hundred gpm. Wells in the Salem Hills and in the Cascade Range foothills yield moderate to small quantities of water and tap a variety of geologic units. Tabulated material includes records of representative wells, drillers' logs, and chemical and spectrographic analyses of the ground water.—MCM

04182 **Helton, Walter L.** Silurian–Devonian stratigraphy of Pulaski County, Kentucky: Kentucky Geol. Survey, ser. 10, Thesis Ser. 2, 35 p., illus., geol. map, 1968.

Exposed strata in Pulaski County range in age from Late Ordovician to Middle Pennsylvanian. A major unconformity separates the Silurian and Devonian Systems. An isolated patch of Boyle Limestone (Middle Devonian) occurs between the Crab Orchard Shale (Silurian) and the Chattanooga Shale (Late Devonian) in an old structural low in the Fishing Creek area, and on a local high inferred on the Crab Orchard erosion surface in the east-central section. The Duffin facies of the Boyle is not developed. The so-called Fishing Creek anticline or dome is reinterpreted as an outcrop pattern resulting from the intersection of a terrace structure with a normal stream profile. Oil was found in 1916 in a "Corniferous" zone, identified as dolomitic rock of the Upper Ordovician Richmond, approximately 100 feet below the Chattanooga Shale.—*from* Author's abstract

Henry, V. J., Jr. *See* Hoyt, J. H. 03977

Heppting, L. M. *See* Jenne, E. A. 04225

04300 **Hertlein, Leo G.** Three late Cenozoic molluscan faunules from Baja California, with a note on diatomite from west of San Felipe: California Acad. Sci. Proc., v. 30, no. 19, p. 401–405, illus., 1968.

The author presents three faunules from fossiliferous strata at localities not previously mentioned in the literature. A small collection of Pleistocene age along the coast between Point Conejo and Arroyo Conejo includes Pelecypoda, Gastropoda, and Cirripedia. Two collections of Pliocene fossils assembled by W. Morlin Childers and from strata exposed west of San Felipe, contain Echinoidea, Pelecypoda, Gastropoda, and a shark tooth, and include 26 species, of which 16 are identified. Of these, 12 now live in the Gulf of California, and 11 are extinct. A number of species are characteristic of the Imperial fauna. A sample of well-preserved, soft, white diatomite from a locality 15 miles west of San Felipe contains 32 identified species and three others identified only as to genus; the assemblage is indicative of late Miocene age.—MST

04387 **Hevly, Richard C.** Archeological pollen analysis—New applications [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 8–9, 1968.

04221 **Hewett, D. F.; Cornwall, Henry R.; Erd, Richard C.** Hypogene veins of gibbsite, pyrolusite, and lithiophorite in Nye County, Nevada: Econ. Geology, v. 63, no. 4, p. 360–371, illus., tables, 1968.

Gibbsite, lithiophorite, pyrolusite, and goethite, plus discrete mixtures of gibbsite and lithiophorite and of gibbsite and iron oxide, occur as replacement veins in limestone. Minor accessories are barite, alunite, opal. Minerals of wall-rock alteration are garnet, idocrase, K-feldspar, prehnite, sericite, and quartz. These silicates formed at higher temperature than the vein minerals, but the whole sequence is considered to be a product of the same solutions, of deep-seated origin, deposited over a long period of time.—WSW

Heyl, Allen V. *See* Hall, Wayne E. 04122

Heyl, Allen V. *See* Roedder, Edwin. 04223

04238 **Heyl, Allen V.** Minor epigenetic, diagenetic, and syngenetic sulfide, fluorite, and barite occurrences in the central United States: Econ. Geology, v. 63, no. 6, p. 585–594, illus., 1968.

Known major mineral districts (zinc, lead, fluorite, barite, celestite) and promising occurrences lie along complex major fault systems, particularly over structural domes at intersections of fault systems. A major system lies near the 38th parallel from West Virginia to Kansas. Promising sulfide deposits occur along this system, particularly near associated cryptoexplosion structures. Trace-element composition, fluid inclusions, depositional temperature, and sulfur-isotope ratios help distinguish potentially economic epigenetic deposits from more widespread, probably uneconomic syngenetic deposits. Other types of deposit of potential interest include red-bed copper and uranium, pyritic black shale and sandstone, and bedded barite.—WSW

04493 **Hide, R.; Horai, K.** On the topography of the core-mantle interface: Physics Earth and Planetary Interiors, v. 1, no. 5, p. 305–308, illus., 1968.

Hypothetical contour maps of the topography of the core-mantle interface are presented, deduced under the assumption that this topography is largely responsible for the spherical harmonic components of the Earth's external gravitational field of degree $n \leq n^*$. Lack of clearcut seismological evidence for undulations of the interface indicates that $n^* < 8$ and there is indirect geomagnetic evidence that $n^* \geq 4$. The vertical distance between highest and lowest points on these maps is 8.7 km when $n^* = 4$, 30.9 km when $n^* = 6$, and 132 km when $n^* = 8$, the corresponding

maximum horizontal stress variations being respectively, approximately 2×10^{-3}, 6×10^{-3}, and 3×10^{-2} times the hydrostatic pressure.—*from* Authors' abstract

04035 **Hill, Mason L.; Hobson, Henry D.** Possible post–Cretaceous slip on the San Andreas fault zone, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 123–127; discussion, p. 128–129, 1968.

The authors contend that the distribution, thicknesses, and facies of the Upper Cretaceous portion of the Great Valley sequence and the possible repetition of the eastern limit of this sequence west of the San Andreas fault can be explained best by some 300 mi of post–Cretaceous right–lateral slip, and that a hypothetical depositional contact between the Franciscan assemblage and the Sierran complex, modified by metamorphism, igneous intrusions, and faulting, may be similarly displaced some 450 mi. This additional 150 mi of right slip could also produce a simple Cretaceous continental margin. It is concluded that this is more likely to have occurred than proposed dip–slip or oblique–slip pull–apart. The concept of hundreds of miles of slip should be accepted to test concepts relating the structure and history of western North America to structures in the northeastern Pacific.—ESL

Hobbs, B. E. *See* Talbot, J. L. 04435

Hobson, Henry D. *See* Hill, Mason L. 04035

04131 **Hoffmann, Victor J.** Zoning and oxidation in the Mapimi mining district, Durango, Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 701, 1968.

04292 **Hoffmeister, J. E.; Multer, H. G.** Geology and origin of the Florida Keys: Geol. Soc. America Bull., v. 79, no. 11, p. 1487–1501, illus., 1968.

The Florida Keys are made of two main formations of Pleistocene age—the Key Largo Limestone and the Miami Limestone. The former is an elevated coral reef rock, and the latter an oölitic limestone. The Key Largo Limestone is the surface rock of the Upper Keys. The Miami Limestone covers the Key Largo for the entire area of the Lower Keys. The Keys are located about five miles from the seaward edge of the Florida coral reef platform. The composition and structure of the platform seaward of the Keys and the coral content of the Keys themselves have led the authors to believe that the Keys were formed as a line of patch reefs in a back reef area bordered by an outer reef which has since been lowered, chiefly by erosion, and covered by more recent material.—*from* Authors' abstract

04046 **Hofmann, Renner B.** Recent changes in California fault movement, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 89–93, illus., 1968.

Fault movements along the San Andreas have been measured since 1959 on over 100 lines. Measurements indicate that movement ranged from four centimeters a year south of Hollister distributed among the three faults to the north, to almost imperceptible amounts to the south. In the San Bernardino area changes in line length suggested regional strain by distortion rather than by fault slippage. This pattern for both the San Francisco Bay area and southern California began to change in 1965; several high–movement rate vectors reversed their direction. Earthquakes near the end of 1967 seem to have restored the usual right–lateral pattern.—ESL

Holland, Heinrich D. *See* Raymahashay, Bikash C. 04076

04310 **Hollister, John C.; Weimer, Robert J.** General summary and conclusions, *in* Geophysical and geological studies of the relationships between the Denver earthquake and the Rocky Mountain Arsenal well, Pt. A: Colorado School Mines Quart., v. 63, no. 1, p. 1–8, illus., tables, 1968.

The majority of the investigators believe that: (1) water injected into the Rocky Mountain Arsenal well has contributed to the Denver earthquake activity by an unknown mechanism, and (2) the relationship between water injection and

earthquake activity could not have been predicted when the well was drilled in 1961.—KAF

04183 **Holmes, Robert F.; Footen, Joseph J.** Selected bibliography of the terrain sciences (2d revised edition): Alexandria, Va., Raytheon Co., 39 p., 1968.

About 500 references are included in the eight sections of the bibliography under the headings: geology, geomorphology, soils, vegetation and land use, engineering photogrammetry, color, multi-sensor interpretation, and general subjects and bibliographies. The compilation is oriented to those professional terrain scientists who use photointerpretative techniques in exploitation of the information content of remote imaging systems.—MCM

Holowaychuk, N. *See* Smeck, Neil E. 04193

04442 **Hooke, Roger LeB.** Steady-state relationships on arid-region alluvial fans in closed basins: Am. Jour. Sci., v. 266, no. 8, p. 609–629, illus., table, 1968.

The steady state exists in a system of fans when all of the fans are increasing in thickness at approximately the same rate. Laboratory and field observations suggest that the steady-state slope of an alluvial fan is determined by debris size, depositional process, and water discharge. Large fans have larger drainage basins and hence larger discharges than small fans. Consequently, fan slope generally decreases with increasing fan area. Under otherwise equivalent conditions, fans composed of coarse material are steeper than those composed of fine material, and fans built largely by debris flows or sieve deposition are steeper than fans on which fluvial processes dominated.—*from* Author's abstract

Hoover, Donald B. *See* Whitebread, Donald H. 03995

04279 **Hopwood, T.** Derivation of a coefficient of degree of preferred orientation from contoured fabric diagrams: Geol. Soc. America Bull., v. 79, no. 11, p. 1651–1654, illus., table, 1968.

Existing tests of the degree of preferred orientation of three-dimensional orientation data are either too sensitive for comparison of diagrams which have an obvious preferred orientation or limited to simple orientation patterns. A coefficient of degree of preferred orientation (Regelungsgrad) is derived that depends on both the magnitude of the maximum concentration and the area of zero concentration, derived planimetrically from contoured diagrams. Calculation minimizes differences in contouring techniques. Comparisons of the degree of preferred orientation of different fabrics can only be made if the number of points in each diagram is the same or a sufficient number of points are used (>350).—RAL

Horai, K. *See* Hide, R. 04493

Hosman, R. L *See* Boswell, E. H. 04517

04047 **Howard, John H.** Recent deformation of the Cholame and Taft–Maricopa areas, California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 94–108, illus., table, 1968.

Deformation in the last 35 years across the San Andreas has been analyzed. Data at Cholame indicate distortion within the zone was greater than without it, increased in 1932–51, declined slightly in 1951–62, and increased sharply in 1962–66; direction of greatest contraction, 1932–66, was north-south. In the Taft–Maricopa area, average strains are small, distortion within the zone is less than without, and direction of greatest contraction 1932–59 was NNW–SSE. Amount and rate of deformation were greater at Cholame, strains across the fault are more contractive and larger there, and shear strains are right-lateral in both areas but larger at Cholame. Comparison of deformation at Cholame before and after the 1966 earthquake shows that expansion was normal to the fault and shear strains along it were not recovered. The fault between these areas should be closely monitored.—*from* Author's abstract

Howard, Keith A. *See* Wilshire, H. G. 04305

04251 **Hoy, E. M.; Gadsby, J. W.; Lea, N. D.** Highway construction over very soft sensitive clay at Sperling Avenue, Burnaby, B.C. [abs.]: Canadian Geotech. Jour., v. 5, no. 3, p. 173, 1968.

03977 **Hoyt, J. H.; Henry, V. J., Jr.; Weimer, R. J.** Age of Late-Pleistocene shoreline deposits, coastal Georgia, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 381–393, illus., table, 1968.

Radiocarbon dates from shoreline deposits of the Georgia coast tentatively suggest ages of approximately 48,000 to 40,000 years B.P. for a +4.5-m submergence, the Princess Anne shoreline, and 30,000 to 25,000 years B.P. for a +2-m submergence, the Silver Bluff shoreline. The older dates are near the extreme limit of radiocarbon determinations and should be cautiously interpreted. A small number of ages from other coastal areas of the world support the idea of two periods of submergence. The 4.5- and 2-m submergences may correlate respectively with the times of glacial withdrawal known as the Port Talbot and Plum Point-Farmdalian interstadials in north-central North America and the Göttweig and Paudorf intervals in Europe.—*from* Authors' abstract

Hudson, Travis L. *See* Maddock, Marshall E. 04034

04348 **Huggins, Maurice L.** The structon theory, applied to crystalline silicates and related compounds: Inorganic Chemistry, v. 7, no. 10, p. 2108–2115, illus., tables, 1968.

The structures of anions in which Si, P, B, and/or Al atoms are tetrahedrally surrounded by oxygen atoms are discussed. Using well-established principles one can deduce, from the over-all formula, the types and relative numbers of *structons* in these anions and also certain other structural characteristics. The structon types in pure silicated, for example, are: Si(4O″), Si(O′,3O″), Si(2O′,2O″), Si(3O′,O″), Si(4O′), O′(Si), and O″(2Si), where O′ and O″ designate nonbridging and bridging oxygen atoms, respectively.—Author's abstract

04538 **Hughes, Travis Hubert.** Minor elements in sulfide minerals of the Hill Mine, Cave-in-Rock district, Illinois [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 659B, 1968.

Hunsaker, V. *See* Bradford, G. R. 04472

04456 **Hunter, John Henry.** Stability of simple cuts in normally consolidated clays [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 596B, 1968.

Hurley, P. M. *See* Krogh, T. E. 04185

04365 **Isacks, Bryan; Oliver, Jack; Sykes, Lynn R.** Seismology and the new global tectonics: Jour. Geophys. Research, v. 73, no. 18, p. 5855–5899, illus., table, 1968.

A comprehensive study of the observations of seismology provides widely based strong support for the new global tectonics which is founded on the hypotheses of continental drift, sea-floor spreading, transform faults, and underthrusting of the lithosphere at the island arcs. Study of world seismicity shows that most earthquakes are confined to narrow continuous belts that bound large stable areas. In the zones of divergence and strike-slip motion, the activity is moderate and shallow and consistent with the transform fault hypothesis; in the zones of convergence, activity is normally at shallow depths and includes intermediate and deep shocks that grossly define the present configuration of the down-going slabs of lithosphere.—*from* Authors' abstract

04289 **Iyer, H. M.** Determination of frequency-wave-number spectra using seismic arrays: Royal Astron. Soc. Geophys. Jour., v. 16, no. 2, p. 97–117, illus., table, 1968.

Comparison of Fourier integral representation of array processing with delay and sum and cross-correlation techniques shows these processes to be simplifications of the Fourier transform method. This represents a new approach to the cross-correlation technique which may enable easier on-line wave-number filtering of seismic signals than the conventional lag method. Data from two seismic events recorded by the Gauribidanur seismic array in India are analyzed to illustrate the techniques.—Author's abstract

Izett, Glen A. *See* Kinney, Douglas M. 03994

04518 **Jeffery, H. G.** Quality of water, *in* Quaternary aquifers in the Mississippi embayment: U.S. Geol. Survey Prof. Paper 448-E, p. E9-E12, illus., table, 1968.

Ground water from Quaternary aquifers of the Mississippi embayment is a moderately hard to very hard calcium bicarbonate or calcium magnesium bicarbonate type containing excessive amounts of iron. Generally the dissolved solids content is less than 500 ppm; locally the content may reach 4,000 ppm. Water containing larger amounts of dissolved solids is a sodium chloride or a sodium sulfate type. The highest dissolved-solids content occurs in southeastern Arkansas and northeastern Louisiana where there is an upward movement of saline water from deeper aquifers. Areas where the dissolved-solids-content is lowest correspond with areas which receive greater amounts of seasonable recharge. Graphs showing relations of cations and anions to total concentrations in water, major-element analyses, and maps are included.—BSH

04225 **Jenne, E. A.; Chao, T. T.; Heppting, L. M.** Use of mercurous chloride to recover trace amounts of gold from waters: Econ. Geology, v. 63, no. 4, p. 420-421, 1968.

Gold can be concentrated and recovered from solutions containing as little as 0.05 parts per billion Au (50-80 percent recovery) by use of a very thin mercurous chloride layer on a membrane filter.—WSW

Johnson, H. S., Jr. *See* Colquhoun, D. J. 04009

Johnson, J. G. *See* Boucot, A. J. 04114

03949 **Johnson, Noye M.** Radiation dosimetry from natural thermoluminescence, Chap. 8.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 451-452, 1968.

The principal use of thermoluminescence today is in absolute radiation dosimetry, through which the vital connection with natural radioactivity is established. The combination of radiation dosimetry with the irradiation-rate process makes age dating and, in part, geothermometry possible. A better means of high quality dosimetry would supercede thermoluminescence, in which accuracy is limited by radiation damage, usually when total dosage exceeds 10^5 r. This would limit simple thermoluminescent dosimetry to post-Pliocene rocks and minerals. A dating tool is most urgently needed for the 10^4-10^5 year period of the Pleistocene-Pliocene where no isotope methods can be applied. Basic validity of the thermoluminescent dosimetry method is demonstrated in the author's study of calcitic fossils (1966, 1967), where radiation dose rates determined from natural thermoluminescence agree well with those calculated from radioactivities.—GDC

03960 **Johnson, Noye M.** Determination of magma temperatures from natural thermoluminescence, Chap. 10.2 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 545-546, 1968.

High temperature thermoluminescence, if high enough, may be completely annealed away. If a magma contacts and heats rock which has pre-existing thermoluminescence, the effect should be progressively less with distance from contact; the pattern, representing "fingermarks" of the volcanic event, may act as a paleothermometer; from heat conduction theory the temperature history for each

point away from regularly shaped igneous bodies can be predicted. From known thermal decay kinetics and activation parameters for the wall rock thermoluminescence, the amount of TL annealing can be calculated. Temperatures thus obtained for limestone–basalt contacts in Arizona (Johnson, 1966) are consistent with known temperatures of molten basalt. The main advantage over other wall rock effects is that thermoluminescence is a "pure" phenomenon, without complicating thermodynamic factors.—GDC

Johnson, Paul G. *See* Carver, Riley D. 04276

04264 **Joiner, Thomas J.** Geology in Alabama: Interstate Oil Compact Comm. Comm. Bull., v. 10, no. 1 (Oil and Gas Compact Bull., v. 27, no. 1, supp.) , p. 73–74, 1968.

The geology of the four physiographic regions—Piedmont, Valley and Ridge, Plateau region, and Gulf Coastal Plain—is reviewed, especially as it concerns oil and gas production.—ESL

04502 **Jones, Robert S.** Gold in meteorites and in the Earth's crust: U.S. Geol. Survey Circ. 603, 4 p., tables, 1968.

The reported gold contents of meteorites range from 0.0003 to 8.74 parts per million. Gold is siderophilic, and the greatest amounts in meteorites are in the iron phase. Estimates of the gold content of the Earth's crust are in the range of 0.001 to 0.006 parts per million.—Authors' abstract

04240 **Joralemon, Peter.** The Wilbur Springs quicksilver district [discussion of paper by Moiseyev, 1968]: Econ. Geology, v. 63, no. 5, p. 573–574, 1968.

Certain ore bodies have been worked for gold as well as quicksilver. The gold–mercury ratio increases toward the center of the district and downward, suggesting zoning about a high-intensity core and a common origin for both metals. Since gold is deficient in surrounding sediments, of the two possible sources for the ore fluid suggested by Moiseyev, the magmatic seems the more likely. (Original paper, ibid., v. 63, p. 169–181, 1968.)—WSW

04242 **Kalliokoski, J.** Economic geology and geochemistry: Econ. Geology, v. 63, no. 5, p. 567–571, 1968.

A gap of potentially serious proportions separates those students of mineral deposits who are primarily interested in problems and processes from those concerned more with the results of a variety of processes as reflected in a particular deposit or class of deposits. This thesis is illustrated by discussion of various topics in the recently published "Geochemistry of hydrothermal ore deposits", edited by H. L. Barnes. These topics include source of magmatic rocks, separation of ore fluid from magma, isotope studies, wallrock alteration, sulfide systems, metal transport, and present-day metal-bearing brines.—WSW

Karig, D. E. *See* Peterson, D. L. 04408

Karlstrom, T. N. V. *See* Ray, L. L. 03990

03991 **Karlstrom, T. N. V.** The Quaternary time scale—A current problem of correlation and radiometric dating, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 121–150, illus., tables, 1968.

The purpose of this paper is to describe briefly the stratigraphic data from Cook Inlet, Alaska, to relate these to the radiometrically-dated interglacial marine deposits from Alaska and elsewhere, and to correlate this combined record with the basic data used in other time-scale reconstructions as a means of delineating the conceptual, procedural, and factual bases for the wide divergencies in current Quaternary interpretations. Some solutions will be suggested, and the main areas of remaining chronologic uncertainty within the Quaternary will be emphasized.—*from* Author's abstract

04314 **Karner, Frank R.** Meteorites in North Dakota—A guide to their recognition: North Dakota Geol. Survey Misc. Ser. 37, 8 p., illus., 1968.

A description of the fall of the Richardton, N. Dak., meteorite is quoted from Quirke (1919) as an introduction. The irregular shape, black glassy fusion crust, shallow pits, and high density are identification aids. Types of meteorites are described and illustrated. Meteorites have several ages, the youngest being the time since fall. Another age dates their breakup in space; the wide range in these dates suggests that collisions in the asteroidal belt are occurring continuously. The age of solidification of meteorite material as well as the time of cooling of the parent bodies can be dated also. These bodies seem to have formed about the same time as the Earth. The age of formation of elements in a star-like body is the oldest. Four finds and one fall in North Dakota are listed; there are undoubtedly many more.—ESL

04444 **Katz, Michael B.** Retrograde contact metamorphism in the granulite facies terrain of Mont Tremblant Park, Quebec, Canada: Geol. Mag., v. 105, no. 5, p. 487–492, illus., 1968.

The Precambrian rocks of the Grenville province of southwest Quebec in the Mont Tremblant Park area consist of granulites and associated gneisses formed under granulite facies conditions which are intruded by members of an anorthosite suite. At the contacts of these intrusives, especially the late-stage members, the granulites and gneisses were found to be retrograded into rocks with mineral assemblages typical of the amphibolite facies. The transformation of the granulite facies rocks into rocks of the lower amphibolite grade can be attributed to local introduction of water which was supplied during the emplacement and crystallization of this late-stage, volatile-enriched magma of the anorthosite suite.—Author's abstract

Kaufman, M. I. *See* Osmond, J. K. 04077

04443 **Kay, Marshall; Eldredge, Niles.** Cambrian trilobites in central Newfoundland volcanic belt: Geol. Mag., v. 105, no. 4, p. 372–377, illus., 1968.

The discovery of species of *Kootenia* and *Bailiella* known from the Middle Cambrian of western Newfoundland ("Pacific Province") and southeastern Newfoundland ("Atlantic Province") in limestone within volcanic rocks near New World Island, eastern Notre Dame Bay, is the first demonstration of the presence of Cambrian in the volcanic belts in North America, and also shows the mixing of forms from the two provinces.—Authors' abstract

Kehn, Thomas M. *See* Wood, Gordon H., Jr. 04245

04196 **Keil, Klaus.** Mineralogical and chemical relationships among enstatite chondrites: Jour. Geophys. Research, v. 73, no. 22, p. 6945–6976, illus., tables, 1968.

The modal composition of 15 of the 16 known enstatite chondrites was determined. Chemical composition, mineral occurrence, and mineral composition were found to depend on degree of recrystallization of the chondrites. Three groups of enstatite chondrites can be distinguished: type I, intermediate type, and type II. An alternative model to the one by Van Schmus and Wood [1967] assumes that major differences in chemical and mineralogical composition between type I and type II were essentially established before or during chondrule formation and agglomeration and that differences in texture are due either to different cooling rates of type I and type II chondrites during and after agglomeration of chondrules or to mild reheating to temperatures $\leq 975°C$.—*from* Author's abstract

04117 **Keith, M. L.** Mantle convection and a unified theory of magmatism, metasomatism, and ore mineral belts [abs.]: Econ. Geology, v. 63, no. 6, p. 704, 1968.

04562 **Keller, George V.** Electrical prospecting for oil: Colorado School Mines Quart., v. 63, no. 2, 268 p., illus., tables, 1968.

This monograph is a collection of notes on the topics covered in a graduate course in electrical prospecting at the Colorado School of Mines. The three areas covered are: (1) the electrical properties of rocks in and around oil fields, (2) the basic electromagnetic theory for current flow in the ground, and (3) practical design considerations for a variety of electrical methods that might be used in prospecting. Electrical properties of the Mesozoic–Cenozoic sedimentary sequence of the eastern Gulf Coast area and of the Paleozoic and Cenozoic sections of the Colorado Plateau, Denver Basin, and High Plains areas are discussed.—KAF

04296 **Kelley, Vincent C.** Geology of the alkaline Precambrian rocks at Pajarito Mountain, Otero County, New Mexico: Geol. Soc. America Bull., v. 79, no. 11, p. 1565–1572, illus., 1968.

Pajarito Mountain is an oval-shaped Laramide dome involving Permian carbonates and red beds with a core of Precambrian rocks. The melanocratic rocks of the core have until recently been thought to be a Tertiary intrusive and perhaps laccolithic. The Permian beds lie on the core rocks unconformably above marked soil profiles of weathering, and radiometric dating shows the Precambrian to be near 1170 m.y. The rocks are predominantly melanocratic types high in amphibole. Fine- to medium-grained syenite is the principal terrane. Locally it is granitized or invaded by a coarser-grained granitoid syenite, and both of these are very locally invaded or converted to hornblende syenite pegmatite. Although hornblende is the predominant amphibole, riebeckite is common, and locally in the pegmatite late-stage aegerine has formed and commonly replaces the hornblende or riebeckite.—Author's abstract

Kemmey, P. J. *See* Vaz, J. E. 03974

03979 **Kempton, J. P.; Hackett, J. E.** The late-Altonian (Wisconsinan) glacial sequence in northern Illinois, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 535–546, illus., 1968.

Radiocarbon dates from peat and organic silts show that late Altonian till occurs just below Farmdale organic deposits and just above an older peat zone. The oldest Farmdalian date is 26,900+1600 or −1300 (I-1625) radiocarbon years B.P. The maximum date of peat beds below the Altonian till is 41,000±1500 (GrN-4468) years B.P. and the minimum is 32,600±520 (GrN-4408) years B.P. A till between these two dated zones demonstrates a late Altonian glacial advance into Illinois between about 32,600 and 26,900 years ago after a significant interval of ice withdrawal. Tills below the lower peat zones are older than 41,000 years and are tentatively correlated with the Winnebago drift and thus are probably early to middle Altonian in age.—*from* Authors' abstract

Kennedy, G. C. *See* Newton, M. S. 04498

04229 **Kennedy, George C.; Nordlie, Bert E.** The genesis of diamond deposits: Econ. Geology, v. 63, no. 5, p. 495–503, illus., tables, 1968.

It is suggested that these mineral deposits were emplaced by an explosive CO_2 gas drive and that the diamond-bearing rocks have come up from a depth of not less than 200 km. CO_2 vacuoles in minerals associated with the diamonds (Roedder) suggest partial pressure of CO_2 equal to confining pressure at time of diamond formation. Thermodynamic calculations show that this condition is required in order to have diamond crystals stable in an environment that contains substantial ferrous and some ferric iron. Thus a vital role is attributed to CO_2 in both the genesis and emplacement of diamond deposits.—*from* Authors' abstract

04249 **Kenney, T. Cameron.** [Discussion of] The performance of a timber crib founded on a very soft sensitive lacustrine clay, by L. S. Brzezinski[1968]: Canadian Geotech. Jour., v. 5, no. 3, p. 178, 1968.

This paper (ibid., no. 1, p. 1–15, 1968) presents excellent evidence that a natural soil can exhibit preconsolidation pressures greater than the maximum effective overburden stress to which it has been subjected. The simplicity of the field

conditions leaves little latitude for interpretation and little margin for error. The importance of this case to understanding of the behavior of natural soils is seemingly inversely proportional to the small cost of the investigation.—ESL

04259 **Kenney, T. Cameron.** A review of recent research on strength and consolidation of soft sensitive clays—Special lecture for the 20th Canadian Soil Mechanics Conference, Quebec City: Canadian Geotech. Jour., v. 5, no. 2, p. 97–119, illus., tables, 1968.

This lecture concentrates on newly developed concepts concerning shear strength and consolidation of soft sensitive clays. Frequently considered as quite separate subjects, shear resistance and compressibility are both measures of the resistance of soils to deformation but for different boundary conditions; both depend on shear movements at contacts between individual mineral particles. Field and laboratory experiences cited bear out certain theories: Stresses in sampled clays are different from in situ stresses; comparisons of compression tests and direct-shear tests are not strictly valid in sensitive clays; undrained strength tests assuming constant water content are unsound, varying with type of test and type of clay; consolidation tests do not necessarily reflect maximum vertical stress, and secondary consolidation may indicate time-dependence for certain soils, or could be due to radial strains.—GDC

04194 **Kerr, Paul F.; Drew, Isabella Milling.** Recent quick-clay studies—[No.] 5, Quick-clay slides in the U.S.A.: Eng. Geology—Internat. Jour., v. 2, no. 4, p. 215–238, illus., 1968.

Any account of quick-clay in the United States becomes primarily an account of landslides at the time of the Anchorage, Alaska, earthquakes of March 27, 1964. Quick-clay triggered by these earthquakes flowed beneath a gravel veneer, and rafted along overlying coarser sediments and many houses. Slides of several types exist at Anchorage: new slides and slumps formed at the time of the earthquake, old slides formed long before the 1964 shock, and monolithic movement where quick-clay passed beneath fairly stable old slide areas. The Anchorage quick-clay, of marine origin, formed at the coast line, but was subsequently elevated and leached of salt; significant clay minerals are illite and chlorite. The constituent smaller than 2μ is on the order of 35–55 percent. Water content prior to movement presumably was high. Thixotropic behavior is apparently a characteristic of much of the fine clay.—*from* Authors' abstract

Kerr, Paul F. *See* Davidson, Donald M., Jr. 04293

04188 **Kesler, Stephen E.** Contact-localized ore formation at the Memé mine, Haiti: Econ. Geology, v. 63, no. 5, p. 541–552, illus., 1968.

This large copper deposit is along the contact of the Terre-Neuve quartz monzonite (66 m.y.) with a large included block of Upper Cretaceous limestone. Following a stage of skarn formation, metallic minerals were deposited in the order: hematite, magnetite, pyrite, molybdenite, chalcopyrite, bornite, chalcocite, and digenite(?). Textural evidence and thermodynamic calculations suggest temperatures between 480° and 640°C for early skarn formation, 350°C (minimum) for early bornite chalcopyrite solid solution and more than 250°C for the latest ore. During mineralization oxygen fugacity decreased from 10^{-18} to 10^{-38} atm and sulfur fugacity from 10^{-4} to 10^{-11} atm.—WSW

04539 **Khaiwka, Moayad Hamid.** Geometry and depositional environments of Pennsylvanian reservoir sandstones, northwestern Oklahoma [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 659B–660B, 1968.

04127 **Kier, Porter M.** Echinoids from the middle Eocene Lake City Formation of Georgia: Smithsonian Misc. Colln., v. 153, no. 2 (Pub. 4738), 45 p., illus., 1968.

A new echinoid fauna is recorded from a test well in Georgia from an interval identified as the middle Eocene Lake City Formation. Three of the six species are unique: *Leniechinus herricki* Kier, new genus and species, *Echinocyamus bisexus* Kier, new species, and *Pentedium curator* Kier. The fauna is unusual in its display of sexual dimorphism, a character rarely seen in fossil echinoids. One of the species

has a brood pouch, and another has females with large genital pores. Presumably these species had large yolky eggs, their young not passing through a pelagic larval stage. The environment probably lacked sufficient plankton for food for the larvae, as in the Antarctic today where sexual dimorphism is common, or a predator was present which fed on the larvae.—Author's abstract

Kimura, Hubert S. *See* Moberly, Ralph, Jr. 04282

04022 **King, Philip B.** Regional relationships of an ancient massif in northwestern Sonora—[Discussion of papers by R. G. Gastil and R. H. Merriam, 1968], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967. Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 288–289, 1968.

These remarks were offered as written discussion following the conference, and information is taken entirely from the literature. In Sonora, not far east of the Gulf of California and south of Caborca, Precambrian and Paleozoic rocks crop out in an area 75 km wide. North and northeast of Caborca the country rocks, Mesozoic continental sediments, volcanics, and metamorphics, with Mesozoic plutons and Tertiary volcanics, continue north into Arizona. The older sequence is miogeosynclinal and very much like that in the Great Basin. Questions are raised as to whether it is more closely related to some Appalachian-type geosyncline, and whether this sequence and the one to the north may have been brought together by faulting.—ESL

King, Robert U. *See* Kinney, Douglas M. 03994

03994 **Kinney, Douglas M.; Izett, Glen A.; King, Robert U.; Taylor, Richard B.** The Poison Ridge volcanic center and related mineralization, Grand and Jackson Counties, Colorado: U.S. Geol. Survey Circ. 594, 8 p., illus., table, 1968.

The Poison Ridge volcanic center of probable middle Tertiary age, in the Rabbit Ears Range, Grand County, Colo., is surrounded by a zoned halo of intense hydrothermal alteration. An inner alteration zone of intensely fractured rock veined by quartz, hematite, and feldspar is surrounded by a zone characterized by quartz, sericite, and pyrite. Geochemical anomalies in the altered area indicate that the altered rock offers a potential target at depth for exploration for disseminated molybdenum and perhaps copper.—Authors' abstract

Kleinkopf, Dean. *See* Mudge, Melville R. 04110

Klepper, Montis R. *See* Tilling, Robert I. 04441

04327 **Klíma, Karel; Kulhánek, Ota.** Quantitative correlation between preferred orientation of grains and elastic anisotropy of marble: IEEE Trans. Geosci. Electronics, v. GE-6, no. 3, p. 139–143, illus., table, 1968.

The dependence between propagation of elastic waves in anisotropic rocks and preferred orientation of grains in the rocks has been under recent intensive study. In conventional visual comparison of both quantities in graphical representation, it is impossible to express the assumed similarity quantitatively. The authors have improved on this by using the cross-correlation approach. According to the quite different characters of both quantities, and to the special properties of the range of definition in spherical samples, a new method was needed for computing the cross-correlation function. This paper deals with experimental data processing and with determining the form of the function. The proposed method was successfully proven on a sample of marble. In this case, the maximum value of the cross-correlation function corresponded to a mutual angular shift of the correlated quantities by approximately 15°.—GDC

04151 **Kneller, William A.** A study of chert aggregate reactivity based on observations of chert morphologies using electron optical techniques, *in* Highway geology symposium, 17th Ann., Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 73–83, illus., table, 1968.

Porous, spongy, intermediate, polygonal, and crystalline morphologies of chert represent possible stages of devitrification and polymerization of fine-grained silica. A change of surface area and crystallinity occurs with grain growth and influences physical and chemical behavior of the chert. The degree of devitrification is a function of time, depth of burial, tectonics, and diagenesis. Porous, spongy, and crystalline chert exhibit the least freeze-thaw durability, the highest solubility, and the greatest alkali chemical expansion. The intermediate and polygonal chert show the lowest total porosity and smaller pore densities and have better cryothermal durability and lower chemical reactivity. Polygonal chert is most susceptible to failure by thermal shock.—*from* Author's abstract

04330 **Kodama, H.; Brydon, J. E.** A study of clay minerals in Podzol soils in New Brunswick, eastern Canada: Clay Minerals, v. 7, no.3, p. 295–309, illus., tables, 1968.

Clays from the Ae and C horizons of five Podzol soils series were examined by X-ray, chemical and infrared absorption methods. Evidence indicated that the Ae horizons contained predominantly a dioctahedral randomly interstratified mica–vermiculite–smectite clay, whereas the C horizons contained abundant dioctahedral mica and trioctahedralchlorite. Since no trace of chlorite was found in the Ae horizons, it was concluded that, while inherited chlorite was decomposed in all Ae horizons, mica was differentially hydrated giving an interstratified structure. Fourier transforms of the three-component interstratified clay revealed different ratios of hydrated layers to nonhydrated layers and different stacking sequences that were related to the degree of weathering as measured by accumulation of TiO_2 in the Ae horizon. They may be related to the degree of podzolization.—*from* Authors' abstract

04376 **Konizeski, R. L; McMurtrey, R. G.; Brietkrietz, Alex.** Geology and ground-water resources of the Deer Lodge Valley, Montana; *with a section on* Gravimetric survey by E. A. Cremer, 3d.: U.S. Geol. Survey Water-Supply Paper 1862, 55 p., illus., tables, 1968.

Deer Creek Valley is dominated by high terraces that slope gently toward the surrounding mountains and end in abrupt scarps above low terraces bordering the Clark Fork flood plain. The valley is filled with more than 5,500 feet of Tertiary erosional and volcanic sediments. Pliocene–Pleistocene erosional features have been modified by stream entrenchment, and alluvial fan and glaciofluvial deposition. The principal source of ground water is the upper few hundred feet of unconsolidated valley fill; depths of wells range from a few to 250 feet and yields range upward to 1,000 gpm. Seasonal fluctuation of the water table is less than 10 feet indicating that recharge balances discharge. Generally ground-water movement is toward Clark Fork from east and west at less than 3 feet per day. The most promising areas for future development are Clark Fork flood plain and Mill and Warm Springs Creeks areas.—*from* Authors' abstract

Kovach, Robert L. *See* Breiner, Sheldon. 04033

Kovach, Robert L. *See* Meister, Laurent J. 04370

Kovach, Robert L. *See* Breiner, Sheldon. 04476

04382 **Kretz, R.** Study of pegmatite bodies and enclosing rocks, Yellowknife–Beaulieu region, District of Mackenzie [with French abs.]: Canada Geol. Survey Bull. 159, 109 p., illus., tables, geol. maps, 1968.

Pegmatite bodies are found in muscovite–biotite granite plutons, dated at 2550 m.y., and in biotite–, cordierite–, and garnet-bearing schists that form broad aureoles about the plutons. The pegmatites consist mainly of quartz, albite, potash feldspar, and muscovite; some contain beryllium, lithium, and niobium–tantalum minerals. The geometry of these steeply dipping dikes suggests that they are fracture controlled dilation dikes. Mineral distribution is normally irregular and composition of minerals is variable. Adjacent country rocks have been altered, the granite, muscovite, tourmaline, and apatite having crystallized at the expense of potash feldspar and biotite, and tourmaline, quartz, and apatite of the schist at the expense

of the biotite and plagioclase. These reactions were accompanied by addition to country rock of boron and phosphorus, and removal of K.—*from* Author's abstract

04410 **Krog, Hildur.** The macrolichens of Alaska: Norsk Polarinst. Skr. 194, 180 p., illus., 1968.

Geographic distribution and chemical properties are enumerated for 326 species of Alaskan macrolichens studied by the author; 11 new species or varieties are described, and four new combinations are made. The present-day distribution is discussed in view of late Mesozoic-Quaternary geological and climatological history, particularly the Pleistocene glaciations and the development of the Beringian land bridge. A close connection with the Asiatic lichen flora is demonstrated. The major part of the Alaskan flora is composed of species belonging to flora-elements dating back to the Tertiary or even further: a circumpolar element; an amphi-Pacific element, now disjunct; a Tertiary circumboreal element traced through relic species with a southern range; and a bipolar element, formerly widely distributed in both hemispheres.—VMJ

04185 **Krogh, T. E.; Hurley, P. M.** Strontium isotope variation and whole-rock isochron studies, Grenville province of Ontario: Jour. Geophys. Research, v. 73, no. 22, p. 7107–7125, illus., tables, 1968.

Rb-Sr whole-rock isochrons were obtained for five granitic bodies and two metasedimentary horizons distributed over a distance of 100 miles in a region of typical Grenville metasediments in southeastern Ontario. Ages of plutonic rocks obtained and their geological significance are as follows: (1) 1285±41 m.y., a time of emplacement for a major pretectonic sill that was deformed on a regional scale; (2) 1103±39 m.y., a maximum value for the time of intense metasomatism that accompanied the formation of the gneisses in the Burleigh paragneiss dome; (3) 1096±50 m.y., a time of emplacement for a major syenite mass that was deformed during regional deformation; (4) 1035±60 m.y., a minimum time for formation of a major sill-like granitic body; (5) 1016±39 m.y., a time of emplacement for a major post-tectonic granite.—*from* Authors' abstract

Krogstad, R. S. *See* Vali, V. 04364

Krouse, H. R. *See* Chrismas, L. 04138

Krouse, H. R. *See* Evans, T. L. 04222

04478 **Krushensky, R. D.; Escalante, G.** Activity of Irazú and Poás volcanoes, Costa Rica, November 1964–July 1965: Bull. Volcanol., v. 31, p. 75–84, illus., 1968.

Irazú volcano in the Cordillera Central of Costa Rica began its most recent activity in mid-March 1963. Murata, Dondoli, and Sáenz (1966) have described the activity of Irazú from 1963 to November 1964. This paper gives a brief historic summary and extends the description of eruptive activity until July 1965. Activity of Irazú after November 1964 continued to be progressively weaker eruptions interspersed with a few relatively strong eruptions. Three boiling mud pots now constitute the strongest activity in the crater. The most recent eruption of Poás volcano is described also.—KAF

04479 **Kubota, S.; Berg, E.** Evidence for magma in the Katmai volcanic range: Bull. Volcanol., v. 31, p. 175–214, illus., tables, 1968.

Several independent observations during the summer of 1965 suggest the presence of magma in the volcanic range of Katmai. A high value of 0.3 for Poisson's ratio and the screening of predominantly the vertical component of the elastic shear waves have been observed. Narrow negative Bouguer anomalies possibly indicate the presence of low density material at shallow depth. The location of magma reservoirs has been attempted, using the calculated wave path and the screening of the mainly vertically polarized shear wave. Of the possible ten chambers thus located, the ones of shallow depth (to 20 km) correspond to the location of active volcanoes. The ones between the 20 km level to the upper mantle seem to spread over a rather

wide area and are not clearly related to the geographical position of a particular volcano.—*from* Authors' abstract

Kulhánek, Ota. *See* Klíma, Karel. 04327

04485 **Kushiro, Ikuo; Syono, Yasuhiko; Akimoto, Syun-ichi.** Melting of a peridotite nodule at high pressures and high water pressures: Jour. Geophys. Research, v. 73, no. 18, p. 6023–6029, illus., tables, 1968.

Melting of a natural peridotite (spinel-bearing lherzolite) nodules from the tuff of Salt Lake, Hawaii, has been studied at pressures between 1 atm and 50 kb under anhydrous conditions and at pressures between 20 and 60 kb under hydrous conditions with the tetrahedral-anvil type of high-pressure apparatus. It appears that under anhydrous conditions magmas of olivine tholeiite composition can be formed from lherzolite, but those of quartz-tholeiite composition cannot be formed by partial melting, at least in the pressure range 10–30 kb. Quartz-tholeiite magma, however, can be formed within a much larger pressure range under hydrous conditions. The solidus under hydrous conditions would give a possible lowest temperature of beginning of melting of the upper mantle.—Authors' abstract

04171 **Kutzbach, John E.; Bryson, Reid A.; Shen, William C.** An evaluation of the thermal Rossby number in the Pleistocene, *in* Causes of climatic change—INQUA-NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 134–138, illus., table, 1968.

The variations in incoming solar radiation (outside the Earth's atmosphere) produced by changes in the eccentricity of the Earth's orbit, Earth obliquity and longitude of perihelion have been recalculated for 10° latitude intervals between 20 and 70 N. at 1000-yr intervals for the past 500,000 yr. The variations in N–S incoming radiation gradient are related to variations in N–S thickness gradient, thermal wind and thermal Rossby number by means of an empirical relationship between radiation gradient and thickness gradient determined from their annual variation. Calculations indicate that changes of about ±5 percent from present day summer half-year thermal winds and about ±2 percent from present day winter half-year thermal winds have occurred. Evidence is cited to show that these variations can be significant.—Authors' abstract

04095 **Lachenbruch, Arthur H.** Rapid estimation of the topographic disturbance to superficial thermal gradients: Rev. Geophysics, v. 6, no. 3, p. 365–400, illus., tables, 1968.

The Jeffreys-Bullard theory of topographic correction to geothermal gradients cannot be applied with confidence if height of relief is large relative to horizontal distance and depth of measurement points. In an important special case, where measurement depth is small relative to distance to relief, the 'superficial' gradient anomaly may be approximated by the value applicable at zero depth. A two dimensional steady-state theory for this case can be based on the solution for heat flux through an inclined plane of arbitrary height and slope, parameters easily represented graphically, so that models which approximate real topography can be identified quickly. Results can be applied to stations on planes, valleys, ridges, or benches bounded by irregular slopes. Very high oceanic heat flows are difficult to explain by undetected relief, but very low ones are not.—*from* Author's abstract

04287 **Lachenbruch, Arthur H.** Preliminary geothermal model of the Sierra Nevada: Jour. Geophys. Research, v. 73, no. 22, p. 6977–6989, illus., table, 1968.

Four heat-flow values from the central Sierra Nevada vary systematically from 1.3 μcal per cm^2 sec near the crest to 0.45 μcal per cm^2 sec at the eastern edge of the San Joaquin Valley. Corresponding heat-production values determined from drill cores range from 0.9 $\mu\mu$ cal per cm^3 sec to 0.07 $\mu\mu$ cal per cm^3 sec. An idealized model makes it possible to reconcile the observed distribution of heat flow, surface heat production, seismic velocities, and crustal thickness, as well as the volume of sediments attributed to post-plutonic erosion of the Sierra and the generation of the Sierra Nevada batholith by anatexis in a great geosyncline. The model implies that in a period of activity ending in early Tertiary the western Sierra was almost

completely purged of heat-producing elements in a time interval of the order of 100 m.y.—*from* Author's abstract

04257 **Ladanyi, B.; Morin, J. P.; Pelchat, C.** Post-peak behaviour of sensitive clays in undrained shear [with French abs.]: Canadian Geotech. Jour., v. 5, no. 2, p. 59–68, illus., table, 1968.

The post-peak stress-strain behavior in undrained shear of three different clays [from three separate locations in Quebec] has been investigated by using an indirect method, which consists in first compressing a clay specimen to a given post-peak strain between two parallel platens and subsequently determining its current remolded strength by the laboratory vane method. By a repeated compression procedure, axial strains of up to 200 percent have been attained. As the three clays tested differed widely in sensitivity, a comparison of their post-peak behavior made clearly apparent the effect of structural breakdown on the reserve shear strength at large strains.—*from* Authors' abstract

04273 **Laidley, Richard A.** X-ray fluorescence of rock samples as applied to geological problems: Appl. Spectroscopy, v. 22, no. 5, p. 420–422, tables, 1968.

Three methods of sample preparation of rock specimens have been evaluated for precision and accuracy. A fusion technique was found to give the best precision. Standard deviations using this method and expressed as percent of the amount present for several elements are: Al 0.83, Si 0.64, K 0.43, Ca 0.43, Mn 0.48, Fe 0.24. Three recent studies of compositional variation were performed on volcanic rocks. Analyses of samples from the Hopi Buttes, Arizona, on obsidian flows from Newberry Caldera, Oreg., and on igneous rocks collected from grids or linear traverses give data which, in each case, are useful in making significant interpretations about the geologic history of the rocks concerned. These examples illustrate the rapidity and high quality of quantitative chemical analyses which can be obtained by application of X-ray fluorescence analytical techniques.—Author's abstract

04501 **Landsberg, Helmut E.** Unfinished geophysical business: Am. Geophys. Union Trans., v. 49, no. 4, p. 607, 1968.

For the fluid part of the Earth there has been a remarkable advance in understanding and forecasting of disasters in recent years, but only slow progress has been made in the area of solid geophysics. Many areas of the world most affected by geophysical disasters are in countries lacking the scientific, technological, and financial resources to keep up with the progress that has been made. Through weather satellites, a far too little recognized worldwide geophysical service has been rendered by the United States; a good deal more should be undertaken in other fields. In this respect the American Geophysical Union can act as a catalyst on the international scene.—DBV

04353 **Lange, Arthur L.** The changing geometry of cave structures—Pt. 3, Summary of solution processes: Caves and Karst, v. 10, no. 3, p. 26–27, 29–32, illus., 1968.

This paper extends the constant and exponential gradients to irregular cave structures, and compares their effects on four initial structures with the speleofacts arising from uniform solution and its variations. Six processes are described and shown in drawings: uniform solution, constant gradient of solution rate, exponential gradient of solution rate, uniform solution below a water surface, stepwise solution rate, and uniform solution with sedimentation.—ESL

Langenheim, R. L., Jr. *See* Gordon, Joan E. 04413

04067 **Langfield, P. M.** Geology of Ford Creek area, Sawtooth Range, Montana [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 213, 1968.

04508 **Langton, J. Roger; Chin, George E.** Rainbow Member facies and related reservoir properties, Rainbow Lake, Alberta, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1925–1955, illus., 1968.

Since discovery in 1965, the Rainbow Lake field in northwestern Alberta has produced from Middle Devonian biohermal reefs collectively designated the Rainbow Member of the Keg River Formation. The reefs are in either Pinnacle or atoll form, have high relief, develop to a maximum height of 800 feet, and in general have thick pay zones with good porosity, excellent permeability and low water saturation. Five reservoir facies, each with a distinct pore system, were identified and a constructed reservoir model provides a method of determining fluid flow.—BHK

Lanphere, M. A. *See* Moore, W. J. 04239

04241 **Lapointe, Guy.** The A horizon in soil surveys and geochemical kit for trace amounts of molybdenum [discussion of discussions by Roy and Paul, 1967, and Bloom, 1968]: Econ. Geology, v. 63, no. 5, p. 572, 1968.

Eh and pH are not primary factors affecting the "sequestration" and selectiveness of chelates for given cations. A restricted definition for "total", such as is suggested by Bloom, is undesirable.—WSW

Larson, E. E. *See* Strangway, David W. 04285

04322 **Law, Charles.** Geochemistry aids oil hunting: Oilweek, v. 19, no. 24, p. 10, 12, 34, illus., 1968.

Geochemical surface surveys may become a practical method in petroleum exploration now that precise analytical services are becoming available. Gas surveys supplemented by geochemical investigations should improve the success record in drilling wells. Acceptance of the theory that various components from hydrocarbon pools migrate through faults and fissures and become absorbed in subsurface soils and dissolved in ground water is growing. Today it is possible to compile gas-anomaly maps using a sampling probe in an auger hole up to ten feet deep, specially designed degassing equipment, and chromatic trace analysis. Methane and ethane are the best indicators because of their volatility. This gas survey eliminates only those locations that show no anomalies. Mass spectrometry to determine C-13/C-12 ratios is an aid in interpreting origins of the anomalies.—ESL

Lea, N. D. *See* Hoy, E. M. 04251

04214 **Leahy, E. J.** (compiler). Crawford township, District of Cochrane (Timmins data series): Ontario Dept. Mines Prelim. Geol. Map P. 487, scale 1 in. to 1/4 mi., text, 1968.

No outcrop is known to occur in Crawford township; the few drill holes available indicate an assemblage of mafic and felsic volcanic rocks accompanied by sedimentary rocks and intruded by mafic, ultramafic, and granitic rocks. Drilling in the magnetic high in the eastern section indicates it to be a differentiated ultramafic body of serpentinite, pyroxenite, and gabbro. Mineral exploration to date has been unrewarding.—MCM

04215 **Leahy, E. J.** (compiler). Whitesides township, District of Cochrane (Timmins data series): Ontario Dept. Mines Prelim. Geol. Map P. 488, scale 1 in. to 1/4 mi., text, 1968.

Mafic metavolcanics with minor felsic volcanic units have been intruded in turn by mafic intrusive rocks of dioritic to gabbroic composition, then granitic rocks, and finally by northerly-trending diabase dikes. From strike and dip data of the metavolcanics, an anticlinal structure has been interpreted in the east-central section. Although gold, chalcopyrite, and nickeliferous pyrrhotite occurrence has been known since the 1920's, exploration has been unrewarding.—MCM

04086 **Leask, D. M.** The geochemistry of Precambrian argillites—Purcell System [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 206, 1968.

Lee, Fitzhugh T. *See* Nichols, Thomas C., Jr. 04005

04449 **LeGeros, Racquel Zapanta.** Crystallographic studies of the carbonate substitution in the apatite structure [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 491B–492B, 1968.

04350 **Leighton, Morris M.** Arthur Charles Bevan [1888–1968]: State Geologists Jour., v. 20, no. 2, p. 25–26, 1968.

04142 **Lemish, John; Welp, Theodore L.** (editors). Proceedings of the 17th annual highway geology symposium, Iowa State University, 1966: Iowa State Univ. Dept. Earth Sci. Pub. 1, 198 p., illus., 1968.

This symposium contains nine articles (cited separately) dealing with various topics of the subject, and eleven articles published as a part of a panel discussion on the chemical and physical reactions of carbonate aggregates in concrete.—HRC

Leonard, A. B. *See* Frye, J. C. 03978

04521 **Levinson, A. A.; Day, J. J.** Low temperature hydrothermal synthesis of montmorillonite, ammonium-micas and ammonium-zeolites: Earth and Planetary Sci. Letters, v. 5, no. 1, p. 52–54, table, 1968.

Hydrothermal syntheses at 300°C indicate formation of montmorillonite-group minerals from several naturally occurring mineral combinations, such as (1) dolomite + kaolinite + quartz, (2) dolomite + illite + quartz, (3) dolomite + feldspar + quartz, and (4) dolomite + feldspar. The addition of ammonia or ammonium hydroxide to the systems will produce such ammonium phases as NH_4-mica and NH_4-analcime. It is suggested that these reactions may take place in rocks under favorable diagenetic and hydrothermal conditions.—Authors' abstract

Levy, P. W. *See* Vaz, J. E. 03974

03983 **Levy, Paul W.** A brief survey of radiation effects applicable to geology problems, Chap. 2.2 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 25–38, illus., tables, 1968.

Radiation produced by accelerators, gamma-ray sources, X-ray machines and reactors—except for neutron components—are indistinguishable from those emitted by the natural sources of radioactivity. The effects of natural alpha, beta, and gamma rays on minerals are the same as the effects which can be laboratory produced in a controlled way. Summarized here, as applicable to geological problems, are: the understanding of difference between ionization and displacement effects; defect formation or displacement processes associated with each type of radiation; additional sources of defects; ionization and charge trapping; thermal stability and retention of trapped charge; radiation induced traps and recombination centers; measurement of defects containing trapped charges; an ideal radiation experiment; and radiation effects on metals.—GDC

03963 **Lewis, D. R.** Effect of grinding on thermoluminescence of dolomite, calcite and halite, Chap. 3.4 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 125–132, illus., tables, 1968.

With wide differences of opinion as to magnitude of the influence of grinding on thermoluminescence and its importance, identical treatment was given three typical rock materials: limestone from Carlsbad Canyon, N. Mex.; dolomite from the Tanyard Formation of Texas; and sodium chloride crystals supplied by a chemical company. Progressing from minimum to far more intense than usual preparation, 1-in discs were ground and frequently sieved into 40- to below 230-mesh particles. Plotted results demonstrate that glow peaks in limestone and dolomite ground to 60–100 mesh are relatively unaffected, but sodium chloride, and probably rock salt, are very sensitive. If application of thermoluminescence is quantitative, such as for dating of rocks or interpreting thermal history, the grinding effect will be significant; where glow curves reflect changes in mineralogy or lithology, it should be less important.—GDC

03964 **Lewis, D. R.** Special considerations in the design of equipment for use in geological studies—Thermoluminescence and exoelectron apparatus, Chap. 3.10 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 183–190, illus., 1968.

Because of statistical sampling and handling of large numbers of samples, instruments to be applid to geological problems need special features for simple and rapid operation, with accuracy in measuring such defect-dominated properties as thermoluminescence, exoelectron emission and others. Five functions are analyzed: heating, detecting, signal conditioning, recording, and calibrating. Thermoluminescence equipment may have requirements such as portability, weight or size limitations, and may be designed for operation in the field, in a base camp trailer, or in a laboratory building. With a large number of repetitive samples to be measured, consideration of the operator's efficiency and convenience become important. Whether for a simple "glow–no glow" indicator or a sophisticated computer, the design should tailor the instrument accurately to measurement needs in every aspect.—GDC

03968 **Lewis, D. R.** Thermoluminescence in sedimentary limestone–dolomite systems [abs.], Chap. 4.6 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 267, 1968.

Leyden, Robert. *See* Worzel, J. Lamar. 04465

Lin, T. H. *See* Giletti, B. J. 04137

04104 **Lipper, Harold W.; Cherry, Carla W.** (compilers). Helium—Bibliography of technical and scientific literature, January 1, 1947, to January 1, 1962, a supplement to Bulletin 484: U.S. Bur. Mines Inf. Circ. 8373, 525 p., 1968.

The bibliography includes 189 references to the occurrence of helium in minerals, natural gases, meteorites, and the atmosphere.—APB

04383 **Lloyd, O. B., Jr.** Ground-water resources of Chowan County, North Carolina: U.S. Geol. Survey Hydrol. Inv. Atlas HA-292, scale 1:125,000, section, text, 1968.

About 2,000 feet of Cretaceous to post-Miocene unconsolidated to partially consolidated sand, silt, clay, limestone, and shell layers, occur between basement rock and land surface in Chowan County as part of the Coastal Plain sediments which dip eastward and thicken to about 10,000 feet at Cape Hatteras. All sediments between land surface and the upper part of the Cretaceous Black Creek Formation contain fresh water in at least part of the area, and can be divided into five aquifers. All aquifers are recharged by local precipitation, most of which occurs in elevated topographic areas where the piezometric surfaces and water table are high. In the northern and northeastern sections water containing high concentrations of chloride is now being diluted and flushed from the north toward the east, south, and west.—MCM

04360 **Lloyd, R. M.** Oxygen isotope behavior in the sulfate–water system: Jour. Geophys. Research, v. 73, no. 18, p. 6099–6110, illus., tables, 1968.

Fundamental data on oxygen isotope behavior in the sulfate–water system are given. Oxygen exchange rates between sulfate ions and water are very slow and show a marked pH dependence. Of the order of 10^3 to 10^5 years are required to closely approach isotopic equilibrium at Earth surface conditions. During progressive evaporation of saturated $CaSo_4$ solution, the gypsum formed tends to concentrate 0-18 relative to dissolved sulfate by 2 per mil. Sulfate-reducing bacteria preferentially metabolize 0-18 by about 4.6 per mil in both pure and natural cultures.—*from* Author's abstract

Lojko, Matthew S. *See* Cord, Marian S. 04357

04525 **Longinelli, A.; Nuti, S.** Oxygen isotopic composition of phosphorites from marine formations: Earth and Planetary Sci. Letters, v. 5, no. 1, p. 13–16, illus., table, 1968.

The oxygen isotopic composition of phosphorites from marine formations of different geological ages has been measured. The results obtained suggest that marine phosphorites of Upper Tertiary age were probably formed under isotopic equilibrium conditions and seem to confirm that 0–18:0–16 variations of the ocean water occurred through geologic time.—Authors' abstract

04123 **Lowell, J. David.** Geology of the Kalamazoo orebody, San Manuel district, Arizona: Econ. Geology, v. 63, no. 6, p. 645–654, illus., 1968.

Discovery of the orebody, a faulted segment of the San Manuel orebody, was based on recognition of: (1) a zonal pattern in which ore is marginal to a low-grade core with potassic alterations—the zone of highest intensity; (2) evidence for post-mineralization tilting of 45° or more; (3) large-scale mullion structure on the tilted San Manuel fault that indicated the direction of offset.—WSW

Lowell, J. David. *See* Guilbert, John M. 04139

04176 **Lowman, Paul D., Jr.** Geologic orbital photography—Experience from the Gemini Program—X-644-68-228: Greenbelt, Md., Goddard Space Flight Center, 34 p., illus., tables, 1968.

Most Gemini flights carried a terrain photography experiment to obtain small-scale color photographs, with hand-held cameras, of selected areas for geologic, geographic, and oceanographic research; nearly 1,100 usable pictures were returned. This paper describes the terrain photography experiment, presents specific geologic applications of the pictures, and discusses advantages and disadvantages of geologic orbital photography. It is concluded that the geologic value and feasibility of orbital photography have been demonstrated. The most promising geologic uses of the photographs appear to be in regional geologic mapping, tectonics, sedimentation, planning of geological and geophysical field work, and interpretation of regional geophysical surveys.—*from* Author's abstract

04319 **Lundgren, Raymond; Sturges, F. C.; Cluff, L. S.** Borehole cameras: Materials Research and Standards, v. 8, no. 8, p. 17–22, illus., 1968.

There is a potential use for borehole or down-hole cameras wherever it would be actually advantageous to see subsurface conditions. Such cameras may be categorized into three types: film, television, and periscope. For clarity of image, the film-type camera is far superior to the television type. The television type gives instant viewing as does the periscope. The latter, however, has restrictive depth limitations. Both film-type and TV-type cameras have been built for use in NX-size diamond drill holes. Under certain conditions, less expensive cameras may be used to obtain data by reaming the core hole to a larger diameter or by drilling an auxiliary, low-cost, non-core hole of larger diameter. Area of advancement in design of borehole cameras is anticipated to be in special-purpose rather than multipurpose types with more than one type camera available on a job.—Authors' abstract

04368 **Luyendyk, Bruce P.; Mudie, John D.; Harrison, C. G. A.** Lineations of magnetic anomalies in the northeast Pacific observed near the ocean floor: Jour. Geophys. Research, v. 73, no. 18, p. 5951–5957, illus., tables, 1968.

Magnetometer observations taken close to the ocean bottom have been made over 500 sq km in the northeast Pacific. Magnetic anomalies measured at the ocean surface are typical Mason-Raff lineations; anomalies observed at depth are more numerous, higher amplitude, and of smaller width than those observed at the ocean surface. The maximum amplitude of these anomalies exceeds 1,000 gammas and their widths vary from 1 to 5 km. The anomalies are lineated and can be traced up to 20 km in the north-south direction over the entire extent of the survey. The surface magnetic anomalies are lineated in the same direction. Echo soundings show that the topography is lineated parallel to the magnetic anomalies. Lower

amplitude, smaller-width anomalies are more prevalent over a topographic valley whereas larger amplitude anomalies are present over its flanking hills.—*from* Authors' abstract

Lynch, J. J. *See* Boyle, R. W. 04234

04457 **Lyons, Charles Gene.** An analysis of waveform generation and transmission in longitudinal impact [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 598B, 1968.

Macauley, George. *See* Proctor, Richard M. 04509

MacCary, Lawrence M. *See* Scott, Glenn R. 04159

MacClintock, Copeland. *See* Pannella, Giorgio. 04494

03950 **MacDiarmid, Roy A.; McDougall, D. J.** (editor). Natural thermoluminescence as a prospecting tool for hydrothermal ores in carbonate host rocks, Chap. 10.3 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 547–556, illus., 1968.

High-temperature traps drained by natural heating may be refilled by natural radioactivity after several hundred thousands of years. Amount of natural thermoluminescence observed must allow for some leakage. During natural heating processes, subtle changes in crystal lattice or foreign ions may affect the trapping potential of minerals; thus equilibrium level may be changed and the thermal history of a rock, relative to its neighbor, may be recorded by the pattern of thermoluminescence. This has led to attempts to use thermoluminescence in geothermometry and prospecting for hydrothermal ores. Its application to prospecting in carbonate rocks, where trace elements confined within a few tens of feet of an orebody should not show effects of metallization very far from the ore contact, was tested in 1,000 samples from 15 known orebodies in the United States, Canada, and Mexico. Of the results described, nearly all were discouraging.—GDC

04315 **MacKean, B. E.** Geology of the Elk Lake area, District of Timiskaming: Ontario Dept. Mines Geol. Rept. 62, 62 p., illus., table, geol. maps, 1968.

In this area of Precambrian bedrock, Cobalt Group sedimentary rocks overlie granitic rocks of the Round Lake batholith with its metavolcanic inclusions; all are intruded by Nipissing diabase dikes and sills. The entire area was glaciated, and at least one extensive sheet of till was deposited. The main structure of the Archean rocks is a foliation aligned in a northeasterly direction. Lineaments in the sedimentary rocks, due to fracture zones and dikes, trend NW–SE and NE–SW. Silver, first discovered in 1906 and carefully explored in the next eight years, seems to be associated with carbonate veins cutting aplite and specularite veins. There are presently no producing mines. Properties are described in detail. Geologic maps of the following townships accompany the report: Chown and Lawson, Mickle and James, and Roadhouse and Willet.—ESL

04424 **Maclay, R. W.; Winter, T. C.; Bidwell, L. E.** Water resources of the Mustinka and Bois de Sioux Rivers watershed, west-central Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-272, 4 sheets, scale 1:250,000, text, 1968.

Sheet 1 includes a map showing aquifers (till and sand deposits), a chart summarizing water resources, and graphs on climate and water yield. Water for municipal supplies is entirely from ground water, most of which is from glacial drift; some from Cretaceous sediments is used locally. The former is very hard, that in the latter ranging from soft to very hard. Sheet 2 refers to surface water. Sheet 3 contains a block diagram, a ground-water probability map with accompanying chart, an analysis of the aquifer at Elbow Lake, and well information for municipal areas. Sheet 4 on quality of water includes maps and graphs. Quality of water from glacial drift is suitable for irrigation where adequate drainage is provided; that

from Cretaceous sediments is unsuitable largely because of excessive sodium content.—MCM

04540 **Macomber, Richard Wiltz.** Articulate brachiopods of the upper Bighorn Formation, Wyoming [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 660B, 1968.

04034 **Maddock, Marshall E.; Hudson, Travis L.** Implications of Franciscan rocks near Pajaro Gap regarding movement along the San Andreas fault [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 121; discussion, p. 122, 1968.

04061 **Mamet, B. L.; Mason, D.** Foraminiferal zonation of the Lower Carboniferous Connor Lakes section, British Columbia: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 147–166, illus., 1968.

The lower Carboniferous of the Connor Lakes section is about three times as thick as type sections of Mount Head and Banff, suggestive of approach of miogeosynclinal conditions. Ten recognized foraminiferal zones contain abundant endemic North American fauna but also Eurasiatic forms which permit recognition of original lower Carboniferous zonation and allows its extension into the Cordilleras. Two anomalies occur in the 'Livingstone' Formation, one the extreme condensation of its lower part where Upper Tournaisian is reduced, second the probable age difference between its top at Connor Lakes and the type Livingstone. The lower unit of the 'Mount Head' correlates to the Salter Member to the east, and the middle unit to the Loomis and Marston Members. 'Etherington' Formation is equivalent to the lower and part of the middle Etherington at its type section.—*from* Authors' conclusions

04097 **Mamet, Bernard L.** Foraminifera, Etherington Formation (Carboniferous), Alberta, Canada: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 167–179, illus., 1968.

The microfauna of calcareous secreting Foraminifera in the type section and nearby exposures of the Etherington Formation discloses affinities with both the Eurasiatic realm and the North American cratonic fauna. The three members of the formation are dated as Early Late Late Viséan, latest Viséan, earliest Namurian and Middle Early Namurian. The Etherington Formation is therefore equivalent to the Chester Group of the Midcontinent.—Author's conclusions

04385 **Martin, Paul S.** Pollen as seen by scanning microscopy [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 8, 1968.

04081 **Martini, I. R.** The sedimentology of the Medina Formation outcropping along the Niagara escarpment (Ontario and New York State) [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 203, 1968.

Mason, D. *See* Mamet, B. L. 04061

Masters, John A. *See* McKenny, Jere W. 04514

04520 **Masuda, Akimasa.** Lanthanide concentrations in the olivine phase of the Brenham pallasite: Earth and Planetary Sci. Letters, v. 5, no. 1, p. 59–62, illus., 1968.

The lanthanide abundances in olivine phase of the Brenham meteorite were reexamined. The result suggests that the previous data on the same material represent a serious impurity effect. This would remove a problem in interpretation of the lanthanide abundance pattern previously obtained for this meteoritic material. The newly measured concentrations of lanthanides are the lowest ones ever found in meteoritic as well as terrestrial silicate material.—Author's abstract

Matson, Neal A., Jr. *See* Richter, Donald H. 04058

04243 **Mattson, Peter H.** Geologic map of the Adjuntas quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I–519, scale 1:20,000, sections, text, 1968.

Contact metamorphism during emplacement of the Utuado batholith has changed parts of the host rocks to hornfels, schist, gneiss, and silicified rock. Epidotized and pyritized rocks are common, as are effects of hydrothermal silicification, sericitization, pyritization, and addition of potassic minerals. Structure is dominated by the northwest-trending Garzas, Cienaga, Cerrillos, and San Patricio faults, referred to as the Ponce fault zone. Resources of economic interest are copper, gold, zinc, iron, manganese, and stone and gravel.—MCM

04244 **Mattson, Peter H.** Geologic map of the Jayuya quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I–520, scale 1:20,000, sections, text, 1968.

Many of the stratigraphic names appearing on the geologic map of the Jayuya quadrangle have been established recently (1960–67). Rocks are broadly folded and highly faulted. Although faults are numerous, only two have been named: the Cerro de Punta and the San Patricio. Faulting and folding occurred in at least two episodes, as shown by the angular unconformity between folded Cretaceous and folded Tertiary rocks. Mineral resources include copper, zinc, and stone and gravel.—MCM

Matumoto, T. *See* Ward, P. L. 04480

04407 **Maurer, Don.** Preliminary report on some littoral foraminifera from Tomales Bay, California: Cushman Found. Foram. Research Contr., v. 19, pt. 4, p. 163–164, 1968.

Twenty-one species of modern calcareous benthonic foraminifera are listed from Tomales Bay, Calif., 40 miles north of San Francisco; results of preliminary work show that the fauna is very similar to that of Sunset Bay, Oreg. (Detling, 1958). A proposed paleoecologic study, to follow the investigation of modern forms, is outlined. The Pleistocene Millerton Formation, which crops out in cliffs and headlands surrounding Tomales Bay, is known to contain foraminifera, although none have been yet described.—VMJ

04268 **Maxey, George B.** Hydrogeology of desert basins: Ground Water, v. 6, no. 5, p. 10–22, illus., 1968.

In the Great Basin two general categories of ground-water flow systems are recognized: (1) local flow systems where drainage areas are small, flow paths are relatively short, interbasin flow is uncommon, springs have large variations in discharge, and water temperature and Na, K, Cl, and SO_4 concentrations are low, and (2) regional flow systems, where drainage areas are large, flow paths long, interbasin flow common, springs have large discharge, and water is usually higher in temperature and K, Na, Cl, and SO_4 concentrations. Hydrologic approaches used, in addition to conventional methods, include hydrologic budget, water potential, and water-chemistry studies. Although detailed delineation of most flow systems in Nevada has not been accomplished, integration of hydrologic, geologic, and chemical methods allow approximate portrayal of many systems, both local and regional.—*from* Author's abstract

04546 **May, Bruce Tipton.** Magnetic properties of rocks associated with the new Cornelia porphyry copper deposit, Pima County, Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 664B, 1968.

04507 **McCamis, John G.; Griffith, Lawrence S.** Middle Devonian facies relations, Zama area, Alberta, *in* Rocky Mountains–Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1899–1924, illus., 1968.

The Zama area, in the Black Creek (salt) basin 200 miles NNE of Peace River, Alberta, produces from the upper reef member of the Middle Devonian Keg River Formation and the overlying Zama Member, a nonreef calcarenite in the Muskeg Formation. Producing zones are underlain by a 400-ft sequence of evaporites and basal red beds which rests on Precambrian granite. Reef limestone outlines the

NE-trending Black Creek basin, but with subsequent subsidence the basin ceased to exist and the Zama area became part of the larger NW-trending Elk Point evaporite basin. Geologic history is illustrated by paleogeographic maps and diagrammatic cross sections; reservoir properties are tabulated.—BHK

04281 **McCammon, Richard B.** The dendrograph—A new tool for correlation: Geol. Soc. America Bull., v. 79, no. 11, p. 1663–1670, illus., 1968.

The dendrograph is proposed as a two-dimensional correlation diagram for depicting the mutual relationships among geologic variables. The dendrograph can display both a within-group and a between-group correlation among variables. This permits a more accurate interpretation of the existing data. A rule for ordering variables within the given hierarchical structure is described which imparts to the dendrograph a pyramid shape and preserves, where possible, the initial rank-order preference among the variables. Statistical tests are needed to ensure that a given dendrograph does not merely reflect a random pattern and that no more than the actual number of groupings of variables is considered significant. An example taken from the literature illustrates how the dendrograph is effective in depicting the mutual correlations among a set of geologic variables.—*from* Author's abstract

McComas, Murray R. *See* Cartwright, Keros. 04269

04318 **McComas, Murray R.** Geology related to land use in the Hennepin region: Illinois Geol. Survey Circ. 422, 24 p., illus., tables, 1968.

Geology and natural resources have implications for land-use planning in the Hennepin region where a major steel plant is to be located. Large supplies of ground water of good quality can be obtained from glacial deposits and bedrock formations and ample surface water is available from 270 miles of streams. Mineral resources include coal, clay, shale, limestone, silica sand, and sand and gravel. Potential problem areas for construction are floodplains of major waterways with high ground-water levels and periodic floods, thick peat and muck deposits, mined-out coal areas subject to subsidence, and bedrock exposures. High terraces are problem areas for waste disposal due to high potential for ground-water pollution. Several sites could be used for ground-water recharge and for waste disposal.—*from* Author's abstract

04186 **McConnell, Robert K., Jr.** Viscosity of the mantle from relaxation time spectra of isostatic adjustment: Jour. Geophys. Research, v. 73, no. 22, p. 7089–7105, illus., 1968.

After allowing for the effects of sea level fluctuations, harmonic analysis of the present level of former shoreline features in southeast Fennoscandia indicates that shorter wavelength departures from equilibrium relax more rapidly than longer ones. These observations together with indicated recent secular decreases in the length of the day would seem to confirm that flow in the upper-mantle low-viscosity channel as a result of the Pleistocene glacial loading is the most likely source of the Earth's nonhydrostatic bulge.—AuthoRs abstract

McCoy, Floyd W., Jr. *See* Moberly, Ralph, Jr. 04282

McCracken, R. J. *See* Nettleton, W. D. 04191

McCracken, R. J. *See* Nettleton, W. D. 04218

McDougall, D. J. *See* MacDiarmid, Roy A. 03950

03959 **McDougall, David J.** Natural thermoluminescence of igneous rocks and associated ore deposits, Chap. 10.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 527–544, illus., 1968.

There is lack of data on thermoluminescence in igneous rocks and minerals and many interpretations appear to be based on hypotheses developed in study of sedimentary environments; these should be viewed with caution, considering

conditions of formation of the minerals. Effects of differentiation, intrusion, metamorphism, metasomatism and tectonic events are often reflected in the level of thermoluminescent emission. Its variations near hydrothermal and metasomatic ore deposits in igneous, metamorphic and sedimentary rocks have been observed by a number of investigators whose initial assumptions and conclusions have not always agreed. In many cases the pattern is more complex than expected from heating or normal distribution of radioactivity, but when interpreted on the basis of solid rock geochemistry and causes of the phenomenon, natural thermoluminescence of igneous rocks and associated ore deposits can be a useful geological tool.—GDC

03981 **McDougall, David J.** (editor). Thermoluminescence of geological materials—NATO Advanced Research Inst. on Applications of thermoluminescence to geological problems, Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, 678 p., illus., tables, 1968.

In this volume, dedicated to Dr. F. G. Houtermans, 58 papers outline developments in the field of thermoluminescence; 40 are cited separately. Progress in the field has been slow, due more to difficulties in interpretation than to limitations of applications in geological and allied fields, although better theoretical understanding, improved instrumentation and advances in techniques have solved many problems. The Proceedings are in four parts: (1) largely history of work at the University of Wisconsin; (2) physics, chemistry, techniques, and instrumentation; (3) various applications to geology and related fields; and (4) classified bibliographies with author and subject indexes.—GDC

04121 **McDougall, David J.** A "lattice-defect—free energy" approach to replacement processes in ore deposition: Econ. Geology, v. 63, no. 6, p. 671–681, illus., tables, 1968.

"Lattice defects due to strain may have played a very significant part in pre-ore ground preparation and the localization of ore zones." Thermoluminescence measurements at four deposits (Royal Flush mine, New Mexico; Merrill Island, Gaspé Copper, and Lake Dufault mines, Quebec) support this conclusion. Defects caused by low-level radioactivity and trace elements commonly appear to be of negligible importance. Fe, Ni, and Co have apparently suppressed thermoluminescence close to ore at Merrill Island and possibly Royal Flush. Recrystallization (skarn) of strained material at elevated temperature seems important at Gaspé Copper.—WSW

McElroy, John D. *See* Browning, David G. 04468

McEvilly, Thomas V. *See* Filson, John R. 04044

04491 **McFadden, C. P.; Smylie, D. E.** Effect of a region of low viscosity on thermal convection in the mantle: Nature, v. 220, no. 5166, p. 468–469, illus., 1968.

If thermal convection in the mantle is to explain sea-floor spreading and heat flow observations, a horizontal scale as large as 10,000 km is required by the tectonic features and as small as 3,000 km by the heat flow measurements. Taking the low viscosity layer into account, it is shown that it may be possible to reconcile convection restricted to the upper 1,000 km of the mantle with the observed horizontal scale of surface features. The critical Rayleigh number for the onset of convection is found to be nearly proportional to the viscosity contrast; thus a fluid layer near marginal stability with a high uniform viscosity would not be far beyond marginal stability with a central minimum several orders of magnitude lower.—DBV

04220 **McGinnis, L. D.** Glaciation as a possible cause of mineral deposition: Econ. Geology, v. 63, no. 4, p. 390–400, illus., table, 1968.

To explain the fact that known Mississippi Valley type districts of the United States lie a short distance beyond the margins of continental glaciation, it is suggested that the ice cap may have caused their formation by (1) consolidation of shales in basins like the Michigan Basin, and (2) increasing the head in recharge areas

beneath the ice cap. Frictional melting would make large volumes of water available for recharge. Both loading and recharge would cause flow of deep-basin water to areas beyond the glacial margin. These waters would have elevated temperature and high mineral content because of their deep source.—WSW

04402 **McGrath, P. H.** An interpretation of the Miramichi Bay magnetic anomaly, New Brunswick: Maritime Sediments, v. 4, no. 1, p. 11–13, illus., 1968.

A quantitative interpretation of the prominent magnetic anomaly centered over the northern half of Miramichi Bay (Canada Geol. Survey Geophysics Paper 805G, Chatham, N.B., sheet 21 P/3) is presented, as part of a program on crustal structure in the Canadian Appalachian Region. In the pre-Carboniferous basement rocks of the Bathurst area, structural grain is dominated by NE-striking folds with steeply dipping axial planes and axes which plunge to the NE and SW. To the east these rocks are unconformably overlain by nearly flat Carboniferous strata, which show local thickening in the Miramichi Bay area. The anomaly there is probably caused by a sedimentary-basic volcanic sequence or by basic intrusives, such as a dike swarm. The top of this disturbing zone is at depth of 6,000 feet, above which the Carboniferous section is 6,000 feet thick.—GDC

04505 **McGregor, Alexander A.; Biggs, Charles A.** Bell Creek field, Montana—A rich stratigraphic trap, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1869–1887, illus., 1968.

The Bell Creek field, an important recent discovery on the east flank of the Powder River basin, currently produces 50,000 bbls of oil per day and has estimated reserves of more than 200 million bbl. At least four reservoirs are delineated in the field by oil-water and gas-oil contacts. Production is from stratigraphic traps in the Muddy Sandstone of Early Cretaceous age. The producing sandstone units are very porous and permeable, pinch out eastward, and are underlain and overlain by organic-rich marine shale. The reservoir rocks were deposited in shallow-water nearshore environments near the intersection of northeast-trending littoral marine bars and a northwest-trending delta system. The traps were formed during a regression between two major advances of the Early Cretaceous sea.—EAM

McIlroy, Paul. *See* Smith, Joseph B. 04001

04211 **McKee, Edwin H.** Geologic map of the Ackerman Canyon quadrangle, Lander and Eureka Counties, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-761, scale 1:62,500, sections, 1968.

04514 **McKenny, Jere W.; Masters, John A.** Dineh-bi-Keyah Field, Apache County, Arizona, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 2045–2057, illus., table, 1968.

The Dineh-bi-Keyah field is producing oil from a porous and fractured Oligocene syenite sill which intruded dark gray dense limestone and shale of Early Pennsylvanian age. The field is at the northwest end of the Toadlena anticline, a northwest-trending surface feature on the northeast flank of the Defiance uplift, but the oil accumulation is primarily stratigraphic. The initial production of individual wells is as high as 3,300 bbl of oil per day.—WCC

04100 **McKinney, Frank K.** A bored ectoproct from the Middle Mississippian of Tennessee: Southeastern Geology, v. 9, no. 3, p. 165–170, illus., 1968.

Silicified ectoproct zoaria referrable to *Meekopora* cf. *M. clausa* (Ulrich), from the Warsaw Limestone of Tennessee were bored by marine organisms, probably polychaetous annelids, based on analogy with Recent marine borings. The boring organisms were probably in search of shelter rather than food since ectoprocts would not supply a sufficient amount of food to repay the energy spent in boring, and the borings are concentrated on one side of the zoaria, which indicates that the zoaria had died and had toppled over onto the sea floor.—Author's abstract

McMahon, B. E. *See* Strangway, David W. 04285

McMurdie, H. F. *See* Swanson, H. E. 04358

McMurtrey, R. G. *See* Konizeski, R. L. 04376

04306 **McMurtry, Wilbur E.** Everett Carpenter (1884–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 9, p. 1799–1800, portrait, 1968.

03965 **Medlin, W. L.** The nature of traps and emission centers in thermoluminescent rock materials, Chap. 4.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 193–223, illus., tables, 1968.

Investigations on basic properties of thermoluminescence in sedimentary rocks included experiments with six common rock minerals: calcite (in most detail), dolomite, aragonite, magnesite, anhydrite and quartz. Two basic processes are involved: trapping and thermal injection, followed by emission at luminescence centers. In synthetic preparations with coprecipitated impurities, emission spectra were clues to the nature of emission centers. Trapping centers were studied in three ways: phosphorescent decay, for energy levels; electric conductivity, for trap emptying processes; and color centers, for details of trap-filling during irradiation and emission production when traps are emptied. Results in calcite lead to a fair understanding of the complete thermoluminescence in carbonates; much less is known about the more complicated noncarbonates.—GDC

03973 **Medlin, W. L.** Thermoluminescence growth curves in calcite, Chap. 3.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 91–101, illus., tables, 1968.

Natural thermoluminescence in limestones is a well known basis for age determination, but little is known about trap-filling kinetics for the high temperature glow peaks—near surface both 500° and 600°K. Studies on the buildup of the 600°K peak in natural and synthetic calcite are reported here. Buildup by alpha irradiation of calcite shows similarities to *F*-center growth curves, as in models proposed for alkali halides. Involving generation of new trapping centers, the curves in synthetic calcite are the more complex, but are equivalent if initially irradiated for long periods. These curves, unaltered by long irradiation of natural samples, imply that natural alpha activity completed generation of new traps, in which case age determination becomes impractical. X-ray irradiation gives the same form of growth curve in both synthetic and natural samples, consistent with two kinds of trapping centers, and no generation of new traps.—GDC

04370 **Meister, Laurent J.; Burford, Robert O.; Thompson, George A.; Kovach, Robert L.** Surface strain changes and strain energy release in the Dixie Valley–Fairview Peak area, Nevada: Jour. Geophys. Research, v. 73, no. 18, p. 5981–5994, illus., tables, 1968.

Observations before and after the 1954 earthquakes in the Dixie Valley–Fairview Peak area have been reduced to surface strain patterns. The strain analysis shows a predominant NW–SE extension in the epicentral areas of the Rainbow Mountain and Fairview Peak earthquakes and NW–SE contraction in adjacent areas. The pattern of strain changes thus conforms to an elastic rebound model. A minimum energy release of 1.3×10^{23} ergs was estimated from the elastic strain changes, which is comparable to the total energy released by the four large 1954 shocks. Net lowering of the ground surface during the earthquakes indicates a release of gravitational potential energy of about 4.3×10^{23} ergs. This energy possibly was dissipated as a minor, undetected uplift in a broad region surrounding the epicentral area.—*from* Authors' abstract

Meister, Robert. *See* Peselnick, Louis. 04371

04066 **Meistrell, F. J.** The spit-platform concept—Laboratory observation of spit development [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 212–213, 1968.

04134 **Mejorada, Pedro Sánchez.** Geology of La Negra mineral deposit, State of Queretaro, Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 702, 1968.

04316 **Melbye, Charles E.** The role of the mining geologist in the Union Pacific natural resource program: Prof. Geologist, v. 5, no. 4, p. 4–5, 1968.

This paper was given as an address at the 1967 Annual Meeting of the California Section of AIPG. The Union Pacific Railroad is expanding and diversifying its efforts in the Natural Resources Division and in the Mining Division in 13 western states. These efforts can be divided into uranium, and all minerals other than uranium. A total of 13 geologists are carrying out the exploration under three district geologists and the Chief Geologist. All types of exploration methods are being used, and studies of the mineral belts are being made using new structural concepts. Large amounts of old mine data are being compiled. The first new mine under the program will be a copper mine at Summitville, Colo. The largest part of the effort now is directed toward uranium exploration.—ESL

04367 **Melson, W. G.; Thompson, Geoffrey; vanAndel, Tjeerd H.** Volcanism and metamorphism in the Mid-Atlantic Ridge, 22° N. latitude: Jour. Geophys. Research, v. 73, no. 18, p. 5925–5941, illus., tables, 1968.

The petrology of the Mid-Atlantic Ridge between 22° and 23° N. lat. may be typical of those portions characterized by a linear topography parallel to the axis, a well-developed median valley, and an absence of volcanic cones. Submarine basalt lavas dredged at 15 stations on the crest of the ridge are of three eruptive facies, all derived from essentially identical magmas: pillow lavas, sideromelane-rich tuffs, and massive, mainly holocrystalline basalts. Chemically, the lavas are oceanic tholeiites and thus support the view that these low-potassium olivine basalts are by far the dominant eruptive on the deep-sea floor. Seven new analyses of major, minor, and trace-elements are presented. New data indicate that faulting and shearing along the median valley combined with introduction of hot, probably saline solutions were major agents in the metamorphism of some basalts.—*from* Authors' abstract

04057 **Mercer, John H.** The discontinuous glacio-eustatic fall in Tertiary sea level, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 77–85, illus., 1968.

Changes in sea level in eastern and western Antarctica and in Greenland are considered. It is shown that a major fall in sea level of about 60 m followed the glaciation of Antarctica followed by a minor fall of about 4–4.5 m. The development of the Greenland Ice Sheet which possibly overlapped the final buildup of ice in eastern Antarctica produced an additional fall of sea level of about 7 m. The temperature drop which led to the formation of the Greenland ice probably marks the Pliocene–Pleistocene transition.—VSN

Merriam, Richard. *See* Woodford, A. O. 04291

04021 **Merriam, Richard H.** Geologic reconnaissance of northwest Sonora [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 287, 1968.

04145 **Michael, Robert D.** Techniques of engineering geology in evaluation of rock cores for construction materials sources, *in* Highway geology symposium, 17th Ann., Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 27–35, illus., 1968.

Cores drilled by commercial materials producers in their exploratory programs may be submitted to the Iowa State Highway Commission for evaluation. Most of these sedimentary rock cores are logged by suites using an area generalized geologic column. Beds are separated into workable "ledges", and samples for physical and chemical tests are taken accordingly. Cross sections are drawn using core locations, relative elevations, and overburden thicknesses. Test data is superimposed on the cross sections to give an overall picture of the formation's potential in regard to construction materials. After prospects are opened into quarries, follow-up

correlations are made between core evaluations and actual ledge conditions and production data.—Author's abstract

Mickey, W. *See* Springer, D. 04372

Midgett, Maryland R. *See* Fishman, Marvin J. 04308

04503 **Miller, V. C.** Current trends in photogeology and in the use of other remote sensing methods in geological interpretation: Earth-Sci. Rev., v. 4, no. 2, p. 135–152, 1968.

The mapping and analysis of photo-detected linear fractures have received considerable attention, and color photography, long awaited, has arrived, but is limited by the expense. Remote sensing, in the visible and invisible spectrum, has been the object of much current activity. The uses of radar and infrared are particularly promising in remote sensing of geologic features and relations. The future of photogeology is certain to be more varied and productive, but one should not assume that the future is already arrived. In the near future the great bulk of the work to be done will still have to be done by time-tested techniques and time-tested instruments.—*from* Author's summary

04161 **Mitchell, J. Murray** (editor). Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, 159 p., illus., tables, 1968.

These papers are published as the outcome of a symposium on causes of climatic change, with emphasis on Quaternary climates and theories of glaciation, which was cosponsored by the International Union for Quaternary Research and the National Center for Atmospheric Research. Authorities in the fields of meteorology, climatology, physical and chemical oceanography, tectonics, volcanology, geochemistry, and solar physics took part in the discussions. Twelve papers are cited separately.—VMJ

04141 **Mitchell, J. Murray, Jr.** Concluding remarks, *in* Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 155–159, illus., 1968.

Mitchell synthesizes the theories of climatic change and glaciation, with emphasis on the Quaternary, that are presented in the 18 papers of this symposium, and points out the significance of the progress being made toward comprehension of atmospheric dynamics and development of a quantitative theory of climate. Nearly all of the aspects of environment which shape climate are believed to vary either rapidly or slowly in geologic time; thus the most important physical causes of climatic change need not be the same from one period of geologic history to another. It is now becoming possible to simulate many details of atmospheric circulation and climate in numerical modeling experiments with electronic computers; validity of several climatic change hypotheses can eventually be checked.—VMJ

04144 **Mitchell, Robert E.** Seismic and resistivity matured, *in* Highway geology symposium, 17th Ann., Iowa State Univ., 1966, Proc.: Iowa State Univ. Dept. Earth Sci. Pub. 1, p. 14–26, illus., 1968.

Seismic and resistivity instruments are an accurate, low cost, and rapid means of determining subsurface conditions to depths of 100 feet, an area of great interest in the highway construction field. Borings can be reduced significantly. A method of complementary usage with both methods is described. Specifically, bedrock depth, refusal areas, bedrock rippability, and joint locations and trends can be determined.—*from* Author's synopsis

04420 **Mitchell, William Spencer.** Sisar Creek area, Ojai oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1967, v. 53, no. 2, pt. 2, p. 35–41, illus., tables, 1968.

The oldest formation drilled in the Sisar Creek area is the nonmarine Oligocene Sespe Formation, penetrated in only one well. The area is bounded on both north

and south by several major faults—Ramona and San Cayetano, and Saugus and Big Canyon, respectively. Oil may occur at any depth below 300 feet; wells with the highest rates produce from the basal part of the Quaternary Saugus Formation, immediately above the Miocene unconformity. Most wells, however, are completed across the unconformity, commingling oil from the basal Saugus and the Miocene Monterey. Below the unconformity the producing formation ranges from a fractured shale to a fractured siltstone, and is saturated with a heavy, tarry oil.—MCM

04282 **Moberly, Ralph, Jr.; Kimura, Hubert S.; McCoy, Floyd W., Jr.** Authigenic marine phyllosilicates near Hawaii: Geol. Soc. America Bull., v. 79, no. 11, p. 1449–1460, illus., tables, 1968.

Amorphous to weakly crystalline detrital muds, eroded from tropically weathered basalt, apparently are rapidly forming illite and montmorillonite in the marine environment near the Hawaiian Islands. Seaward changes in alumina–silica ratios, nonexchangeable cations, and mineralogy, as well as young K–Ar ages, support the interpretation that a substantial part of the marine clay near the Islands is authigenic. Other investigators have shown that part of the marine chlorite has replaced gibbsite. The evidence is not sufficient to show what amount of the kaolinite also found in the muds, if any, is authigenic. These results support the theory that reactions between ocean water and silicates are a major factor in alkali ion fixation and pH control of the oceans.—Authors' abstract

04106 **Moore, B. J.; Shrewsbury, R. D.** Analyses of natural gases, 1967: U.S. Bur. Mines Inf. Circ. 8395, 187 p., tables, 1968.

Analyses for helium and other components are reported for 547 samples of natural gas collected as part of a continuing survey of helium resources of the free world. Samples include 436 from gas and oil wells in 21 states, 41 from wells in 2 other countries, 36 from pipelines in 5 states, and 34 from foreign pipelines.—ERL

04354 **Moore, Ellen J.** Fossil mollusks of San Diego County: San Diego Soc. Nat. History Occasional Paper 15, 76 p., illus., 1968.

In this simple but serviceable collecting guide for fossil mollusks of the San Diego area, 64 species are described briefly and illustrated by photographs, natural size where practicable. Species included (32 pelecypods, 30 gastropods, one cephalopod, and one scaphopod) are common in the area, or highly distinctive, or were first collected in or near San Diego. Following a brief terminology for each of the four classes, the species descriptions are grouped by epoch: Late Jurassic, Late Cretaceous, Eocene, Pliocene, Pleistocene, with a generalized outcrop map for each.—VMJ

04207 **Moore, Frank B.** Geologic map of the Hodgenville quadrangle, Larue and Nelson Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–749, scale 1:24,000, section, text, 1968.

Gas in quantities for household use was found in five test holes for oil east of Hodgenville, one well supplying gas for 14 years and the other for about 17 years. Limestone has been quarried from the St. Louis Limestone and from a lens near the top of the Borden Formation. A calcareous shale near the base of the Salem Limestone has been used to a limited extent as a soil conditioner.—MCM

04453 **Moore, Larry Joe.** Isotopic fractionation in Hawaiian volcanic gases [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 510B, 1968.

04332 **Moore, Ruth; Time–Life Books Editors.** Evolution (Young Readers Edition): New York, Time–Life Books, 128 p., illus., 1968.

The book is divided into six parts entitled: Darwin's voyage into the past, a theory that shook the world, solving the riddle of heredity, cracking the "code" of living things, a half billion years of creation, and the search for mankind's ancestors.—ESL

04239 **Moore, W. J.; Lanphere, M. A.; Obradovich, J. D.** Chronology of intrusion, volcanism, and ore deposition at Bingham, Utah: Econ. Geology, v. 63, no. 6, p. 612–621, illus., tables, 1968.

K–Ar dates range from 39 to 32 m.y. and suggest that: (1) Plutonism, volcanism, and hydrothermal activity were sequential stages in a magmatic history of about 7 m.y. duration. (2) Latitic volcanic rocks, in part, postdate the stocks. (3) Sulfide mineralization and hydrothermal alteration followed emplacement of the monzonitic stocks and at least the earliest units in the volcanic sequence; the time interval between intrusion and alteration was probably less than 1 m.y. (4) Rhyolites of Shaggy Peak, which may represent terminal differentiation products, are the youngest igneous rocks.—*from* Authors' abstract

Moores, Eldridge M. *See* Burk, Creighton A. 04028

03966 **Morency, Maurice.** An investigation of the effects of pressure on thermoluminescence, Chap. 4.3 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 233–239, illus., 1968.

In this study, confining pressure tests were carried out on samples of homogeneous calcitic limestone and fairly uniform syenite. The failure curve for limestone is nearly linear with increasing pressure, that for syenite is much steeper. Results of thermoluminescence investigations were similar for both materials. It could be inferred, on a preliminary basis, that changes of thermoluminescence might be related to points on the stress–strain diagrams where there was no deformation, but no satisfactory correlation could be obtained between its cyclicity and the increasing pressure load. No definite conclusions can be presented because of the apparent complexity of the pressure effect, but it is hoped that the results may stimulate research on this special problem.—GDC

Morin, J. P. *See* Ladanyi, B. 04257

04175 **Morisawa, Marie.** Streams—Their dynamics and morphology: New York, McGraw–Hill Book Co. (Earth and Planetary Sci. Ser.), 175 p., illus., tables, 1968.

This book is an attempt to explain some of the "secret" forces by which water works in order to clarify some of the mystery of rivers in terms which are understandable with little or no previous knowledge of the subject. Chapter headings are: introduction; hydrology; hydraulics of streams; transportation of the sediment load; fluvial processes—erosion and deposition; slope and channel morphology; graded profile or the steady state; channel pattern; and river basin. Name and subject indexes are included.—MCM

Morris, M. C. *See* Swanson, H. E. 04358

03989 **Morrison, R. B.** Means of time–stratigraphic division and long–distance correlation of Quaternary successions, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 1–113, illus., 1968.

Time–stratigraphic division and long distance correlation of Quaternary successions pose special problems that are not encountered in older deposits. The proximity to the present and high degree of exposure has encouraged ultradetailed study and subdivision. Two feasible patterns for correlation are: (1) separation into individual glacial stages and interglacial stages that are practically coeval, and (2) each stage comprises a full glacial–interglacial cycle, commencing with a glaciation and ending with soil formation on the till. Depositional succession is commonly the basis of correlation, but many difficulties can be overcome by using soil–stratigraphic units as time–stratigraphic markers, at least in temperate zones, to provide a framework for long distance correlation.—*from* Author's summary

03988 **Morrison, Roger B.; Wright, Herbert E., Jr.** (editors). Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA,

1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, 631 p., illus., tables, 1968.

The papers in this volume, by an international group of scientists, discuss nearly all methods used to correlate stratigraphic successions of Quaternary deposits, regionally, transcontinentally, and intercontinentally. The volume is divided into six parts: part 1, five papers on principles and philosophy of Quaternary correlation; part 2, six papers on isotopic dating and paleomagnetic correlation; part 3, one paper on volcanic ash correlation; part 4, four papers on climatic changes; part 5, eight papers on glacioeustatic shoreline changes; and part 6, eight papers on multiple methods. Those pertinent are cited separately by author.—HRC

Moss, R. W. *See* Vali, V. 04364

04078 **Mothersill, John S.** Environments of deposition of the Halfway Formation, Milligan Creek area, British Columbia: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 180–199, illus., 1968.

Before deposition of the Halfway Formation the Triassic sea regressed southwestward and the Milligan Creek area was part of a gently sloping coastal plain. The Halfway Formation forms the base of an onlap sequence that was deposited as the Triassic sea again transgressed northeastward. The detrital material probably came from the northeast and was carried south by longshore drift. The 'upper' sandstones of the Beatton, Milligan, Willow, Wildmint and Bulrush trend were formed as longshore bars during a pause in the northeastward transgression, when the rate of supply of detrital material was low. The 'upper' sandstones at Peejay and Currant which occur parallel to and to the southwest of the Beatton to Bulrush trend were initially formed as deeper-water longshore bars that later evolved into barrier beaches during a limited marine regression.—*from* Author's abstract

Moullade, Michel. *See* Butterlin, Jacques, 04324

04550 **Mound, Michael C.** Arenaceous Foraminiferida and zonation of the Silurian rocks of northern Indiana: Indiana Geol. Survey Bull. 38, 126 p., illus., tables, 1968.

This report describes 82 species belonging to 31 genera of Silurian Foraminiferida from cores from northern Indiana. The families Ammodiscidae Reuss, Astrorhizidae Brady, and Saccamminidae Brady represent the superfamily Ammodiscacea Reuss. The family Hormosinidae Haeckel represents the superfamily Lituolacea de Blainville. *Ammodiscus constrictodilatus, Lituotuba recurva, Tholosina phrixotheca,* and *Psammonyx ceratospirillus* are new species. The pre-Cayugan Silurian rocks are assigned to three biostratigraphic assemblage zones: the *Turritellella*, the *Ammodiscus–Thurammina*, and the *Ammodiscus–Lituotuba*.—KAF

04469 **Mower, R. W.; Feltis, R. D.** Ground-water hydrology of the Sevier Desert, Utah: U.S. Geol. Survey Water-Supply Paper 1854, 75 p., illus., tables, geol. map, 1968.

In the Sevier Desert, fluviatile deposits interbedded with alluvial-fan, lacustrine, and eolian deposits form a hydrologic system more than 1,000 feet thick and comprised of two main artesian aquifers and a water-table aquifer. Recharge is by direct precipitation, seepage from streams and irrigated areas, movement from consolidated rocks, and underflow from other basins. Dissolved chemicals range from 195–6, 360 ppm. Water in most of the inhabited areas is suitable for most uses. The Leamington–Oak City–Delta area has the greatest potential for future development. Since 1950, water levels have declined 4–7 feet near centers of pumping. Evapotranspiration in areas that support phreatophytes is not a serious problem as yet but could become so if saltcedar spreads. The amount of water that could be obtained from storage if the piezometric surface in the artesian aquifer were lowered 20 feet is estimated to be 120,000 acre-feet.—BSH

04110 **Mudge, Melville R.; Erickson, Ralph L.; Kleinkopf, Dean.** Reconnaissance geology, geophysics, and geochemistry of the southeastern part of the Lewis and

Clark Range, Montana: U.S. Geol. Survey Bull. 1252-E, p. E1-E35, illus., tables, geol. map, 1968.

Reconnaissance geological and geochemical studies identify a narrow northwest-trending, 30-mi long belt and indicate stratigraphic and structural control of its weak lead-zinc mineralization; geophysical data permit inferences of location of buried plutons, the possible source of the metals. Mineralization appears to be spatially related to the South Fork thrust zone which contains Precambrian and Paleozoic rocks. Anomalous quantities of lead and zinc occur in the Spokane Formation, Helena Dolomite, Flathead Sandstone, and Jefferson and Three Forks Formations. Magnetic and gravity data were used in defining the area for studies of the many major magnetic anomalies that indicate buried plutons. One large positive anomaly, west of the belt's center, may have a genetic relation to the lead-zinc mineralization.—*from* Authors' abstract

Mudie, John D. *See* Luyendyk, Bruce P. 04368

04462 **Muffler, L. J. Patrick; Doe, Bruce R.** Composition and mean age of detritus of the Colorado River delta in the Salton Trough, southeastern California: Jour. Sed. Petrology, v. 38, no. 2, p. 384-399, illus., tables, 1968.

The northwest landward extension of the Gulf of California structural depression is filled with fine-grained sandstones and siltstones of the Colorado River delta. All are late Cenozoic and average 20,000 feet thick. Provenance is primarily from Mesozoic sedimentary rocks of the upper Colorado drainage basin. Wide ranges in both major and minor elements can be correlated with grain size and clay content of the samples. Lead isotope data from delta samples indicate that the mean age is 1700 m.y., and strontium isotope data indicate the mean age is greater than 500 m.y. In view of the small percentage of exposed Precambrian rocks in the upper Colorado River drainage basin, the bulk of the acid-soluble detritus (as measured and cited above) probably consists of reworked detritus of Precambrian age.—*from* Authors' abstract

Multer, H. G. *See* Hoffmeister, J. E. 04292

Munsart, Craig A. *See* Newman, Walter S. 04551

Myers, W. Bradley. *See* Hamilton, Warren B. 04027

03958 **Nash, Douglas B.** Efficiency of proton-excited luminescence of silicate rock powders [abs.], Chap. 11.4 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 587, 1968.

04030 **Nason, Robert D.** San Andreas fault at Cape Mendocino, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 231-240, illus.; discussion, p. 240-241, 1968.

North of Point Arena, the fault curves northward and crosses the shelf on a strike N. 12° W., which would intersect the coast near Shelter Cove where there was movement in the 1906 earthquake. Tolo Bank, extending south of the cove, is composed of upfaulted Franciscan schists, similar to that forming bluffs at Point Delgada. The shape suggests faults on both sides; three lines of fractures have been traced inland from Shelter Cove. The San Andreas fault was not found farther north and probably lies offshore; it may continue to bend westward to follow the Gorda escarpment, part of the Mendocino fracture zone, as it does in the Transverse Ranges to follow the Murray. The fracture zones show opposite displacement but the San Andreas bends the same way on both; the fracture zones may be older, and the fault is conforming to lines of weakness. This makes large offsets on the fault seem unlikely.—ESL

Nason, Robert D. *See* Rogers, Thomas H. 04049

04323 **Neathery, Thornton L.** Talc and anthophyllite asbestos deposits in Tallapoosa and Chambers Counties, Alabama: Alabama Geol. Survey Bull. 90, 98 p., illus., tables, 1968.

The deposits are associated with a complex group of calcic-magnesium mafic and ultramafic rocks, part of a discontinuous belt extending from Alabama to Newfoundland; the rocks crop out in narrow arcuate bands for about 20 mi. Mapping indicates that the regional structure is a broad synform trending northeast. Amphibolite zones are extensive and numerous. The mafic and ultramafic rocks have been involved in one or more periods of regional metamorphism. Four processes of alteration are recognized, with steatitization and amphibolization predominating. Most asbestos occurrences are found in the eastern part of the belt. Talc is predominantly a 'talc-rich' soapstone occurring in the saprolite overlying the complex. [About 40 pages are devoted to descriptions of properties.]—*from* Author's abstract

04132 **Neilson, James M.** Geology of the Cerro Nahuatl iron ore deposits, Colima, Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 701, 1968.

04003 **Nelson, Arthur E.** Geology of the Ohio quadrangle, southwestern part of the Adirondack Mountains, New York: U.S. Geol. Survey Bull. 1251-F, p. F1-F46, illus., tables, geol. map, 1968.

Bedrock in the Ohio quadrangle consists of Precambrian paragneisses and orthogneisses that have been subjected to regional metamorphism. The oldest are metasedimentary rocks of the Grenville Series: younger plutonic rocks include those ranging in composition from metagabbro to granite gneiss. The parent sediments of the metasedimentary rocks were probably mixtures of graywacke, quartz sand, clay, and tuff. The rocks derived from these sediments were reconstituted and recrystallized to produce the Grenville rocks, and some were later metasomatized and converted into granite gneiss. Except for some diabase dikes and pegmatites, all the Precambrian rocks were plastically deformed during the late stages of metamorphism. This deformation produced the present fold structures.—*from* Author's abstract

04109 **Nelson, W. H.; Ross, C. P.** Geology of part of the Alder Creek mining district, Custer County, Idaho: U.S. Geol. Survey Bull. 1252-A, p. A1-A30, illus., tables, geol. map, 1968.

In the Alder Creek mining district, stocks of quartz monzonite, granite, leucogranite porphyry and related dikes, and volcanic rocks, all of early Tertiary age, seem to be differentiates of a single parent magma. The stocks have metamorphosed sedimentary rocks of the Copper Basin Formation and the White Knob Limestone, both from Early Mississippian to Early Permian in age; limestones have been in part isochemically metamorphosed to marble, and in part metasomatized to skarn. Valuable concentrations of copper, lead, and zinc minerals occur in the skarn, and mostly within skarn at the contact between the leucogranite porphyry and limestone. Glacial deposits of two ages and alluvial deposits of two ages occur in the report area.—WHN

04087 **Netolitzky, R. K.** Geology of the Kipahigan Lake copper-nickel sulphide deposit, Saskatchewan [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 206, 1968.

04191 **Nettleton, W. D.; McCracken, R. J.; Daniels, R. B.** Two North Carolina Coastal Plain catenas—[Pt.] 2, Micromorphology, composition, and fragipan genesis: Soil Sci. Soc. America Proc., v. 32, no. 4, p. 582-587, illus., tables, 1968.

Soils of an older catena have bisequal profiles, and in most cases fragipans, whereas the soils of a younger catena have monosequal profiles but no fragipans. Reduction and removal of the iron may have started the secondary clay movement cycle that produced the bisequal profiles. Accumulation of silt and fine sand in channels and voids above the B't horizon produced the compact fragipan horizon. Infrared absorption peaks and consistence of fragipan materials suggest that fragipan

brittleness results from H-bonding between amorphous clays and quartz or other silicates in the soil matrix.—*from* Soil Brief

04218 **Nettleton, W. D.; Daniels, R. B.; McCracken, R. J.** Two North Carolina Coastal Plain catenas—[Pt.] 1, Morphology and fragipan development: Soil Sci. Soc. America Proc., v. 32, no. 4, p. 577–582, illus., tables, 1968.

Two soil catenas of the Coastal Plain of North Carolina were studied. The older catena [on the Sunderland surface] formed in feldspathic sediments and the wetter members have fragipans and bisequal profiles. The younger catena [on the Wicomico surface] formed in quartz-rich sediments and fragipans are absent in most soils. The younger catena has finer textured B horizons and thinner sola than comparable members of the older catena. The moderately well-drained members of the two catenas are similar.—Authors' abstract

04551 **Newman, Walter S.; Munsart, Craig A.** Holocene geology of the Wachapreague lagoon, eastern shore peninsula, Virginia: Marine Geology, v. 6, no. 2, p. 81–105, illus., 1968.

Wachapreague lagoon and defending barrier islands have been in existence for at least 5,500 years. Submergence, continuing at a decreasing rate, has controlled the evolution during the last 4,400 years. Crustal upwarping, marine regression, or both, affected the area prior to 4,400 years B.P. Prior to 1,000 years B.P., the lagoon consisted of open bays and tidal flats. Extensive development of tidal marshes began about 1,000 years B.P., owing to some combination of sedimentation and decreased submergence rate. Comparison of later Holocene submergence curves for the Atlantic coast strongly suggests that crustal subsidence has affected the Wachapreague area over the past 4,400 years and that the locus of maximum subsidence follows a line extending from central New Jersey coast to the vicinity of Cape Cod.—*from* Authors' abstract

04498 **Newton, M. S.; Kennedy, G. C.** Jadeite, analcite, nepheline, and albite at high temperatures and pressures: Am. Jour. Sci., v. 266, no. 8, p. 728–735, illus., tables, 1968.

The equilibrium P–T curves for the following have been determined: albite = jadeite + quartz; albite + nepheline = 2 jadeite; analcite = jadeite + water. The curves for albite = jadeite + quartz is P(bars) = 6800 + 18.6 T°C. The reaction albite + nepheline = 2 jadeite is shown by P(bars) = −4000 + 25 T°C, and the curve for the reaction analcite = jadeite + H_2O has been reversibly located at temperatures of both 500° and 600°. The slope of the reaction is P(bars) = 9.5 T°C + 6000 and is consistent with theoretical considerations; the other curves agree with previously-determined curves. The curve for the reaction analcite = albite + nepheline + water has been located to within ±3 kilobars at 600°C.—*from* Authors' abstract

04005 **Nichols, Thomas C., Jr.; Abel, John F., Jr.; Lee, Fitzhugh T.** A solid-inclusion borehole probe to determine three-dimensional stress changes at a point in a rock mass: U.S. Geol. Survey Bull. 1258-C, p. C1–C28, illus., 1968.

In order to relate changing stress conditions within rock masses to geologic factors, a welded high-modulus solid-inclusion borehole probe to determine three-dimensional stress changes at a point in a rock mass was developed and tested. The reliability of the probe is established by conducting a series of tests in which the probe was subjected to changing hydrostatic and triaxial stress fields. In all these tests the probe responded as predicted by elastic theory. Because reduction of field measurements is difficult and time consuming, computation of the three-dimensional stress tensor has been programmed for computer analysis. The probe will aid in the understanding of anisotropic rock behavior associated with tunneling and other underground or near-surface engineering operations.—*from* Authors' abstract

04515 **Nicholson, Alex.** Louise Jordan (1908–1966): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 2058–2059, portrait, 1968.

04416 **Noble, Donald C.; Christiansen, Robert L.** Geologic map of the southwest quarter of the Black Mountain quadrangle, Nye County, Nevada: U.S. Geol. Survey Misc. Geol. Inv. Map I-562, scale 1:24,000, section, 1968.

Noe-Nygaard A. *See* Berthelsen, A. 04466

Nordlie, Bert E. *See* Kennedy, George C. 04229

04286 **Normark, William R.; Shor, George G., Jr.** Seismic reflection study of the shallow structure of the Hawaiian arch: Jour. Geophys. Research, v. 73, no. 22, p. 6991-6998, illus., 1968.

Seismic reflection profiling northeast of the Hawaiian Islands shows that many areas of low relief on the crest and outer limb of the Hawaiian arch are free of sediment. Adjacent hills and ridges commonly have as much as 150 m of folded and faulted sediment. On several submarine plains, discontinuous sections of undisturbed stratified sediment adjoin areas with no detectable sediment; in these unsedimented areas, the sea floor is hummocky, with a relief of 2 to 10 m. These contacts are characterized by a progressive loss in penetration, but no basement horizon is seen to crop out from under the sediments. It is suggested that a sedimentary archipelagic apron, which extended 400 km northeast of the islands, was folded and faulted during formation of the arch. Large areas of low-lying sediment appear to have been intruded and covered by subsequent volcanic flows.—Authors' abstract

04297 **Normark, William R.; Curray, Joseph R.** Geology and structure of the tip of Baja California, Mexico: Geol. Soc. America Bull., v. 79, no. 11, p. 1589-1600, illus., table, geol. map, 1968.

The submarine geology of the continental margin at the tip of the peninsula has been mapped through the use of continuous reflection profiling. A sequence of folded and faulted sediments, correlated with the exposed Pliocene Salada Formation, unconformably overlies the volcanics and pyroclastics, correlated with the Commondú Formation, and granitic rocks, correlated with the Baja California pluton. Thirty-five dredge hauls, collected by Shepard from submarine canyons in the region, have substantiated these correlations. Northeast-striking normal faults of the continental terrace suggest uplift of the southern part of the peninsula. Uplift of the region associated with normal faulting and strike-slip movement on the major La Paz fault are related to the formation of the Gulf as the continent overrode the East Pacific Rise since late Miocene.—RAL

Norris, A. W. *See* Sanford, B. V. 04265

04266 **Norris, A. W.; Sanford, B. V.; Bell, R. T.** Bibliography on Hudson Bay Lowlands: Canada Geol. Survey Paper 67-60, p. 47-118, 1968.

This bibliography, compiled for Operation Winisk, deals primarily with bedrock and surficial deposits of the Hudson Bay Lowlands and peripheral Precambrian terrain, but also includes references on other topics that would be useful to further exploration. Included are some that deal with outliers and larger outcrop belts of Paleozic age related to and surrounding the lowlands.—*from* Authors' abstract

Novitzki, R. P. *See* Cotter, R. D. 04378

04473 **Nriagu, Jerome O.** Sulfur metabolism and sedimentary environment—Lake Mendota, Wisconsin: Limnology and Oceanography, v. 13, no. 3, p. 430-439, illus., tables, 1968.

The suite of sulfur compounds in the sediments of Lake Mendota, [Madison, Wis.] is made up of sulfide dissolved in the interstitial water, acid-volatile sulfide, elemental sulfur, organic sulfur, and sulfates. Its dominant form in the sludge is a black, amorphous, acid-soluble substance believed to be hydrotroilite. No pyrite or marcasite was isolated from these bottom muds. Nearly 45 percent of the sulfur precipitated as sulfide is apparently derived from mineralization of organic matter with the remaining fraction coming from bacterial reduction of sulfates. Sulfur analyses coupled with other evidence suggest that prior to the change in

sedimentation associated with human activity Lake Mendota had developed an oxygen deficiency intense enough to cause the reduction of sulfates to sulfides but was able to maintain its basin free of black muds by processes of self-purification.—*from* Author's abstract

Nur, Amos. *See* Simmons, Gene. 04073

Nuti, S. *See* Longinelli, A. 04525

04356 **Oberg, Maurice.** Evaluation of quartz in airborne dust in the 0.5- to 2-micron size range: Environmental Sci. and Technology, v. 2, no. 10, p. 795–798, illus., 1968.

A quantitative method is described by which the percentage of quartz in airborne dust is determined by X-ray diffraction. The method makes use of an Andersen dust sampler to separate the airborne dust into several aerodynamic particle size ranges of pathological interest. A laboratory dusting apparatus is described which is used for the preparation of a standard series and for the addition of the internal standard, calcium fluoride, of the same particle size range as the collected dust sample. The method provides information regarding the mass concentration in air, particle size distribution, percent composition, and changes in percent composition with size. The method makes use of membrane filters in the final analysis and is suitable for collected dust samples of 500 micrograms or greater.—Author's abstract

03987 **Obradovich, J. D.** The potential use of glauconite for late-Cenozoic geochronology, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 267–279, illus., tables, 1968.

Two criteria are needed to apply use of glauconites for K-Ar dating: glauconitization must be complete, and the sample must not contain reworked glauconite. A high age will result if either of these is violated. The Lomita Marl Member of the San Pedro Formation, California, is used as an example. A mean age of 3 m.y. was obtained for this Pleistocene formation. Glauconitization is probably complete, and data on the concentration of Rb and Sr isotopes clearly indicates that no reworked glauconite is present.—HRC

Obradovich, J. D. *See* Moore, W. J. 04239

Obradovich, John D. *See* Tilling, Robert I. 04441

O'Brien, Kathryn G. *See* Gordon, Joan E. 04413

04401 **O'Brien, Neal R.** Electron microscope study of Pleistocene diatoms: Maritime Sediments, v. 4, no. 1, p. 7–10, illus., 1968.

Reported here, with electron micrographs, are nannofossil diatoms present in Pleistocene clay in the St. Lawrence valley, which suggest conditions of deposition relative to salinity of the Champlain Sea. Near Massena, N.Y., the clay directly overlies Ordovician dolomite, but up and down stream it overlies two distinctive tills. Of the 17 genera and 31 different species of diatoms identified, about half are brackish water forms, one fourth tolerate fresh water of high mineral content, and one fourth are cold watermarine forms. It seems that the contact between brackish and marine water, which has been considered to be southwest of Massena, near Ogdensburg, N.Y., should be placed at Massena, where diatom rich clay was deposited in brackish water of an estuary extension of the Gulf of St. Lawrence.—GDC

04153 **Ohmoto, Hiroshi; Rye, Robert O.** The ores of the Bluebell mine, British Columbia—A product of meteoric water? [abs.]: Econ. Geology, v. 63, no. 6, p. 699, 1968.

04342 **Oklahoma Geological Survey.** Arthur Curtis Shead, 1891–1968: Oklahoma Geology Notes, v. 28, no. 5, p. 178, portrait, 1968.

04160 **Oldale, Robert N.** Geologic map of the Wellfleet quadrangle, Barnstable County, Cape Cod, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-750, scale 1:24,000, section, 1968.

04204 **Olive, Wilds W.; Davis, R. W.** Geologic map of the Oak Level quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-744, scale 1:24,000, section, text, 1968.

Mineral resources of the Oak Level quadrangle include gravel and sand, and ceramic grade clay from the Wilcox Formation and upper part of the Porters Creek Clay. Slump blocks are common in areas of moderate to steep slopes where the Porters Creek Clay is overlain by continental deposits.—MCM

04029 **Oliver, H. W.** Discussion [of "Evidence for right-lateral movement on the Owens Valley, California, fault zone during the earthquake of 1872, and possible subsequent fault creep", by M. G. Bonilla, 1968], *in* Conference on geologic problems, San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 5, 1968.

Oliver, Jack. *See* Isacks, Bryan. 04365

04006 **Olsen, S. J.** Miocene vertebrates and north Florida shorelines, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 127-134, illus., 1968.

Vertebrate fossils from ten localities, spread across northern Florida, give evidence of shorelines and deltas that have previously been established on geologic evidence or invertebrates alone. Terrestrial mammal remains, in association with shallow-water forms, indicate a deltaic assemblage. Fortunately diagnostic fragments of Miocene horses, *Merychippus* and *Parahippus*, are present in these beds, allowing for a rather close age-evaluation of these sediments. Adequate fossil material has been collected from these localities to suggest the past environment and ecological conditions for the forms represented. By utilizing a suggested course of experiments with stream table apparatus it is possible to use the orientation of the fossil vertebrate remains as aids in determining past conditions of sediment accumulation.—*from* Author's summary

04080 **Onions, Diane.** Dimensional grain orientation of Ordovician turbidite greywackes [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 203, 1968.

04206 **Orkild, Paul P.** Geologic map of the Mine Mountain quadrangle, Nye County, Nevada: U.S. Geol. Survey Geol. Quad. Map GQ-746, scale 1:24,000, sections, 1968.

04077 **Osmond, J. K.; Rydell, H. S.; Kaufman, M. I.** Uranium disequilibrium in ground water—An isotope dilution approach in hydrologic investigations: Science, v. 162, no. 3857, p. 997-999, illus., table, 1968.

The distribution and environmental disequilibrium patterns of naturally occurring U-234 and U-238 in waters of the Floridan aquifer suggest that variations in the ratios of isotopic activity and concentrations can be used quantitatively to evaluate mixing proportions of waters from differing sources. Uranium is probably unique in its potential for this approach, which seems to have general usefulness in hydrologic investigations.—Authors' abstract

04412 **Outerbridge, William F.** Geologic map of parts of the Majestic , Hurley, and Wharncliffe quadrangles, Pike County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-748, scale 1:24,000, section, text, 1968.

Coal in the map area is mined principally from the Williamson, Upper Cedar Grove, Lower Cedar Grove, Alma, and Pond Creek coal beds, the latter being the most important. Natural gas is produced from the Mississippian Ravencliff and Maxton sands of the Pennington Formation and the Big Lime or lower member of the Newman Limestone, the Mississippian or Devonian Berea Sandstone, Devonian Ohio Shale, and Silurian Big Six sandstone; principal productive formations are

the Berea and Newman. Sandstone of the Breathitt Formation has been used locally as dimension stone, and sand and gravel from alluvium has potential value.—MCM

Palmquist, John C. *See* Ray, Clayton E. 04379

04541 **Pampe, William Riley.** Biostratigraphy of the Devonian rocks of western Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 660B–661B, 1968.

04494 **Pannella, Giorgio; MacClintock, Copeland; Thompson, Maxwell N.** Paleontological evidence of variations in length of synodic month since Late Cambrian: Science, v. 162, no. 3855, p. 792–796, illus., table, 1968.

The values of length of synodic month, obtained from tidally controlled periodical growth patterns in mollusks and stromatolites for several geologic periods, indicate that the deceleration rate of the Earth's rotation has not been constant. Two breaks in slope, in the Pennsylvanian and Cretaceous, may be related to changes in distribution of continents, oceans and adjacent shallow seas.—Authors' abstract

Pare, J. J. *See* Sainani, U. R. 04252

04101 **Parker, John M., 3d.** Structure of easternmost North Carolina Piedmont: Southeastern Geology, v. 9, no. 3, p. 117–131, illus., 1968.

A structural geologic map based on reconnaissance and scattered published data is presented that covers some 4,000 sq mi in eastern Piedmont North Carolina, east of the Deep River Triassic basin. The region is a great anticlinorium that plunges southward. The axial area is occupied by granitic plutons surrounded by zones of high-rank metamorphic rocks ranging up to kyanite grade. These in turn are flanked by low-rank metasedimentary and metavolcanic rocks of the graywacke suite, of Paleozoic or perhaps late Precambrian age. Foliation in most rocks parallels the compositional layers. Granitic bodies also occur along both the eastern and western belts of low-rank rocks, and a swarm of ultramafic lenses lies in the high-grade rocks west of the central pluton. Several anticlines and synclines are located in the low-rank and high-rank rocks on the flanks of the major anticlinorium and other unidentified isoclinal folds must exist.—Author's abstract

04103 **Parker, Raymond L.; Fleischer, Michael.** Geochemistry of niobium and tantalum: U.S. Geol. Survey Prof. Paper 612, 43 p., tables, 1968.

This report summarizes work on the geochemistry of niobium and tantalum published since Rankama's treatise. A glossary and bibliography are included. The abundance of niobium and tantalum in the Earth's crust is about 20 and 2 ppm respectively. Abundance tables for different rocks show that niobium is most abundant in alkalic rocks, and alkalic mafic and ultramafic rocks. Tantalum generally accompanies niobium in an abundance of one-tenth to one-fifteenth that of niobium, although it is extremely low in some niobium-rich alkalic complexes. The highest content of niobium in sedimentary deposits is in deep-sea manganese nodules and in bauxites, whereas the highest tantalum content is in marine clays and bauxite. Niobium and tantalum in meteorites are a fraction of their clarke values, although tektites have a tantalum content similar to that of the Earth's crust.—*from* Authors' abstract

04192 **Parsons, R. B.; Simonson, G. H.; Balster, C. A.** Pedogenic and geomorphic relationships of associated aqualfs, albolls, and xerolls in western Oregon: Soil Sci. Soc. America Proc., v. 32, no. 4, p. 556–563, illus., table, 1968.

The distribution of Willamette, Woodburn, Amith, Concord, Holcomb, and Dayton soils is related to deposits and geomorphology of the main floor of the Willamette Valley. Clay-textured alluvium was the parent material for the formation of Dayton, Concord, and Holcomb B horizons. Amity soils occur on low knolls where clay was not deposited. Willamette, Woodburn, and Holcomb soils have thick A1 horizons partly as a product of overbank alluvial deposition along natural levees. Soil formation has resulted in organic accumulation, base eluviation, iron and

manganese segregation into concretions, and argillic horizons. The soils contain one or more discontinuities and have not been derived from the weathering in place of "Willamette Silts" as previously reported. Chemical properties may reflect initial differences in the parent materials as well as subsequent soil development.—Authors' abstract

Parsons, T. R. *See* Seki, H. 04471

04158 **Patchen, Douglas G.** High success ratios, initial flows promise good times for Newburg: Oil and Gas Jour., v. 66, no. 46, p. 122–128, illus., 1968.

The Newburg Sand (Upper Silurian Williamsport Sandstone) has become the principal deep target in the search for natural gas in West Virginia. Three gas fields are being developed in this thin but extensive sheet sandstone which underlies most of the state. Gas accumulation in two of the fields is associated with anticlinal structures and in the third field results from stratigraphic trapping on the regional dip slope. A brief resume of Newburg exploration in West Virginia is included.—HHA

04313 **Patchick, Paul F.** Ground-water research in Central America completed: Water Well Jour., v. 22, no. 10, p. 32–33, illus., 1968.

The United Nations Food and Agricultural Organization in cooperation with the El Salvador Ministry of Agriculture has completed a 3-year ground-water exploration and evaluation project in the lower basin of the Rio Grande de San Miguel as a pilot example of a good approach to a regional evaluation. Good quality ground water with a sufficient usable recharge of 25 percent was located to irrigate 40,000 hectares. The presence of a vast aquifer system is estimated to contain 12.27 million acre-feet of ground water of which 1.34 million acre-feet occurred in storage within the first 300 feet below the surface. Recommendations have been implemented by legislation for further drilling and development.—MCM

Paul, Roger R. *See* Carey, Andrew G., Jr. 04560

04107 **Pavlides, Louis.** Stratigraphic and facies relationships of the Carys Mills Formation of Ordovician and Silurian age, northeast Maine: U.S. Geol. Survey Bull. 1264, 44 p., illus., tables, geol. map, 1968.

The Carys Mills Formation in northeastern Maine is an impure limestone sequence that spans Middle Ordovician to Early Silurian times. Locally, it is underlain by the Chandler Ridge Formation and conformably overlain by the Burnt Brook Formation. It also grades upward into and, in part, is the lateral equivalent of the Silurian Smyrna Mills, Perham, and Sprague ville Formations, indicating that its depositional basin was one of uninterrupted sedimentation during the Taconic orogeny. The rocks of Middle Ordovician age of the Carys Mills are the calcareous equivalents of Middle Ordovician eugeosynclinal suites of rocks that occur west of the outcrop belt of the Carys Mills. The Pyle Mountain Argillite of Late Ordovician age is also a western temporal equivalent of part of the Carys Mills.—LP

Pearce, D.C. *See* Walker, J. W. 04284

04351 **Pearl, Richard M.** Geology simplified—Keynote guide to topics in your course: New York, Barnes and Noble, 89 p., illus., 1968.

This study aid, designed to help a student review his geology course, consists of a self-test, explanations of answers, basic facts, and additional information. A dictionary index and a final examination are included.—MCM

Pelchat, C. *See* Ladanyi, B. 04257

04371 **Peselnick, Louis; Meister, Robert.** A note on the rate of the 15-kb phase transition in limestone: Jour. Geophys. Research, v. 73, no. 18, p. 6117–6119, illus., 1968.

The response of the shear velocity in limestone to a step function of hydrostatic pressure reveals a time associated with permanent transient deformation at regions of high local stress and a time associated with the kinetics of the phase transition. Comparison of the times for phase transformation measured in this study with the time required for the calcite-to-aragonite transition obtained by Davis and Adams [1965] shows that the new phase cannot be aragonite. Estimates from this study and shock wave data show that the time for transformation to take place is less than 10 seconds but greater than a few microseconds. It is estimated that less than 0.5 percent of the transformation to the new phase is detectable with the present precision in velocity and pressure.—Authors' abstract

04248 **Pestrong, Raymond.** The role of the urban geologist in city planning: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 10, p. 151–152, illus., 1968.

Since the failure of the St. Francis Dam near Los Angeles in 1928, California has made it illegal to construct a dam without prior geologic investigation. Geologists have been acting as part-time consultants, but each community located in an area of potential hazard should have a staff of urban geologists. In the San Francisco Bay area, some of the most sought-after land is in the fault block terrain, many housing tracts are astride the trace of the San Andreas fault, and water tanks are close to fault traces; along the Bay, houses are built on unstable soft muds. The urban geologist could outline zones of potential hazard, and once foundation problems are clarified, safe structures can be built. After the danger areas are outlined, the urban geologist could serve as a consultant on problems of waste disposal, water resources, pollution, and construction of dams, tunnels, etc.—ESL

Petersen, Jean D. *See* Cord, Marian S. 04357

04408 **Peterson, D. L.; Popenoe, Peter; Gaca, J. R.; Karig, D. E.** Gravity map of the Trinidad quadrangle, Colorado—A contribution to the Upper Mantle Project: U.S. Geol. Survey Geophys. Inv. Map GP-638, scale 1:250,000, 1968.

04189 **Peterson, Donald L.** Bouguer gravity map of parts of Maricopa, Pima, Pinal, and Yuma Counties, Arizona: U.S. Geol. Survey Geophys. Inv. Map GP-615, scale 1:250,000, 1968.

04130 **Petruk, William.** The silver deposits in the Cobalt–Gowganda area in Ontario, Canada [abs.]: Econ. Geology, v. 63, no. 6, p. 699–700, 1968.

04227 **Petruk, William.** Mineralogy and origin of the Silverfields silver deposit in the Cobalt area, Ontario: Econ. Geology, v. 63, no. 5, p. 512–531, illus., tables, 1968.

Veins with carbonates, arsenides, native silver, and sulfide cut Huronian metasedimentary rocks below a Nipissing diabase sill. "The predominant arsenides in the upper parts of the ore veins are those of Ni, in the mid-portions, Co, and in the lower parts, Fe." Silver grade is highest with Ni–Co mixtures, lowest with Fe. Textural relations suggest a common origin for the arsenides and native silver. Chalcopyrite, freibergite, and other sulfides occur in both ore veins and wall rock as veinlets and disseminated grains. The sulfides were present in the underlying Keewatin rocks prior to deposition of the ore, and have probably entered the veins by remobilization.—WSW

Phillips, Tom L. *See* Andrews, Henry N. 04277

Pickard, Greenleaf W. *See* Gómez, Manuel. 04115

04542 **Pine, Gordon Leroy.** Devonian stratigraphy and paleogeography in Gila, Graham, Greenlee, and Pinal Counties, Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 661B, 1968.

04433 **Piwinskii, A. J.** Experimental studies of igneous rock series, central Sierra Nevada batholith, California: Jour. Geology, v. 76, no. 5, p. 548–570, illus., tables, 1968.

Samples of a granite, two granodiorites, and a tonalite from the Sierra Nevada batholith were treated at pressures up to 3 kb with 15 wt percent H_2O, noting the P–T curves for the solidus and for the disappearance of feldspars, quartz, biotite, and hornblende. Runs as long as six months were required to approach equilibrium in some samples. The magmas as emplaced would seem to have been a eutectic-like granitic liquid with suspended crystals of calcic plagioclase, hornblende, and magnetite, possibly left over from melting of crustal material.—REW

Poetz, Jo Ann. *See* Frey, Fred A. 04359

Popenoe, Peter. *See* Peterson, D. L. 04408

04369 **Porath, H.** Magnetic studies on specimens of intergrown maghemite and hematite: Jour. Geophys. Research, v. 73, no. 18, p. 5959–5965, illus., table, 1968.

The direction and intensity of remanent magnetization of intergrown maghemite and hematite have been studied as a function of the hematite content by heating artificial specimens of maghemite under an astatic magnetometer at temperatures of 540° and 580°C in a field of 1.08 oe. The remanence vector during the inversion from maghemite to hematite is directed along the applied field and is not controlled by the magnetization of the host mineral, maghemite. An anomalously high remanence is observed for hematite contents of 92 to 95 percent. Thermal demagnetization shows this magnetization to be primarily due to the residual maghemite. It is suggested that spin exchange interactions across the interface of intergrown maghemite and hematite are the cause of the high remanence.—*from* Author's abstract

04519 **Pratt, Richard M.** Alantic continental shelf and slope of the United States—Physiography and sediments of the deep-sea basin: U.S. Geol. Survey Prof. Paper 529-B, p. B1–B44, illus., 1968.

The major topographic provinces beyond the continental slope off the Atlantic coast of the United States are the Sohm Plain, Hatteras Plain, Nares Plain, Blake Basin, Blake Plateau–Bahama Banks, and Bermuda Rise. The topographic detail of the area is the result of processes of sediment transport and deposition on the deep-sea floor. Sediments spreading seaward have formed a secondary sea floor covering an initial or primary volcanic sea floor and associated seamounts and abyssal hills. Terrigenous, carbonate, and glacial-sediment source areas cross the continental shelf and slope and extend into the deep sea. The sedimentary record on the continental margin and in the deep sea indicates uniform basining of the area since Early Cretaceous time without major faulting or volcanism.—RMP

04474 **Press, Frank.** A strategy for an earthquake prediction research program, *in* Earthquake prediction—Proceedings of a symposium, Zürich, Switzerland, 1967: Tectonophysics, v.6, no. 1, p. 11–15, 1968.

Problems in earthquake forecasting are reviewed and the Japanese program of research and the planned United States program are discussed briefly. A properly balanced program should show the following distribution: instrumentation of seismic zones, 35 percent; earthquake engineering and seismic regionalization research, 30 percent; geological and geophysical studies of seismic regions, 15 percent; research on physical basis of earthquakes (mostly laboratory), 10 percent; and miscellaneous, 10 percent. Since earthquakes are a matter of public concern, scientists should not make premature statements or oversell their program on its progress. If the research program is too small, poorly founded negative results might prejudice a more ambitious and potentially more successful program. International cooperation is essential.—VSN

04126 **Proctor, Paul Dean; El-Etr, Hasan A.** Layered pegmatites, southern Wind River Mountains, Fremont County, Wyoming: Econ. Geology, v. 63, no. 6, p. 595–611, illus., tables, 1968.

Layered pegmatites, a few inches to several hundred feet in width, range from rounded to elongate (length/width = 1 -> 10), and from fine to coarse grained. Most

intrude tightly folded low- to medium-grade schists, some concordantly, others discordantly. Some intrude stocks and a batholithic mass of granite, to which the pegmatites are zonally and probably genetically related. Magnetite-bearing pegmatites are in and near the batholith; graphic granite-bearing pegmatites are in and around a sill-like granite body. Tourmaline-garnet pegmatites occupy a central granite-free area. Largest and most abundant are garnet pegmatites, widespread, but most numerous in the central area.—WSW

04509 **Proctor, Richard M.; Macauley, George.** Mississippian of western Canada and Williston basin, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1956-1968, illus., 1968.

Originally, continuous Mississippian-age shallow-water marine deposits extended over western Canada and parts of the Precambrian shield, but post-Mississippian—pre-Cretaceous erosion separated and isolated these rocks, leaving three distinct areas of more complete preservation: the Williston basin, southern Alberta, and northern Alberta-British Columbia. These basins have been treated independently as depositional entities; geologic, political, economic and human factors have created "barrier boundaries" which inhibit understanding Mississippian sedimentation. This paper identifies and examines these barriers and seeks to stimulate a broader approach to the geology involved.—BHK

04528 **Purushothaman, Krishnier.** Transport of ^{85}Sr and ^{137}Cs under induced clay suspensions [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 637B, 1968.

04253 **Quigley, R. M.** Discussion [of] Landslide on the Toulnustouc River, Quebec, by R. J. Conlon [1966]: Canadian Geotech. Jour., v. 5, no. 3, p. 175-177, illus., 1968.

After publishing the paper (ibid., v. 3, no. 3, p. 113-144, 1966), Mr. Conlon gave the writer a small block of undisturbed clay for compositional and fabric analyses. The quartz content was 15-20 percent of the sample, and at least as much feldspar is present. The soil contains abundant illite and chlorite and smaller amounts of vermiculite and swelling clay. Citrate extractions run on the soil prove it is similar to the Leda clay in the Ottawa area, but has more horizontal parallelism of clay platelets than the Leda. The writer believes the strong bonding is related to aluminum and iron hydroxide precipitates in the soil.—ESL

04260 **Quigley, Robert M.** Soil mineralogy, Winnipeg swelling clays: Canadian Geotech. Jour., v. 5, no. 2, p. 120-122, illus., 1968.

The mineralogical composition of swelling clay soils from the Winnipeg area of Manitoba is summarized, with a figure showing typical X-ray diffraction traces of the clay. Soil samples from test borings were brown near surface and dark gray-brown at depth, all characterized by pockets of silt-size material speculated to be lumps rafted into Lake Agassiz by icebergs. Two X-ray powder patterns on the clay matrix around the lumps showed no sign of dolomite, the major constituent of the silt pockets. The clayey portion of the soils exclusive of the silt lumps is estimated to consist of interlayered montmorillonite-illite, 80 percent; kaolinite, 5-10 percent; and quartz, 10-15 percent. A more detailed account may be found in Univ. Western Ontario Engineering Sci. Research Rept. SM-1-67 (Quigley, 1967).—GDC

04458 **Raba, Carl Franz, Jr.** The static and dynamic response of a miniature friction pile in remolded clay [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 601B, 1968.

04050 **Radbruch, Dorothy H.** New evidence of historic fault activity in Alameda, Contra Costa, and Santa Clara Counties, California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 46-54, illus., 1968.

New evidence of creep in the Hayward fault zone in three places—Richmond, southern Oakland, and Hayward—consists of offset of curbs and sidewalks, railroad tracks, and fences. In Hayward, streets and buildings are damaged also, and in

one place movement seems to be on two traces bracketing the 1868 rupture. Tectonic creep within the Calaveras fault zone and Pleasanton faults has been recorded near Dublin and Camp Parks, and possible thrusting to the northeast along the Calaveras. No visible evidence has been found along the Calaveras, but fences are offset on the Pleasanton faults. Surface rupture in San Ramon and Amador Valleys, probably in the Calaveras zone, accompanied a severe earthquake in 1861. Damage to the spillway of Coyote Dam may be due to creep on this fault.—ESL

04088 **Raham, G. O.** Geology of the Big Ledge zinc deposit, British Columbia [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 207, 1968.

03972 **Ralph, Elizabeth K.; Han, Mark C.** Progress in thermoluminescent dating of pottery, Chap. 7.2 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 379–387, illus., table, 1968.

Thermoluminescence dating of ancient pottery has an advantage over C-14 in that the actual artifact is dated, unlike charcoal which may have no association at all with an occupational level. In experimental work at the University of Pennsylvania since 1958, improvements are due to two observations: that the identical sample measured for thermoluminescence must be bombarded and remeasured for susceptibility correction, and that decay of low-temperature components in artificially-induced glow peaks require correction for rate of alpha bombardment. For detection of thermoluminescent photons emitted upon heating, the furnace must be fast and pottery layers very thin. Average uncertainty in dating is ±300 years, but may be less for better fired pottery made of more homogeneous clay. Tree-ring chronology may be extended to 6,000 years; however, pottery fired 10,000 years ago has already been found.—GDC

04197 **Randall, John A.** Hydrothermal feldspar dikes in the framework of the Tayoltita silver-gold orebodies [abs.]: Econ. Geology, v. 63, no. 6, p. 701, 1968.

04363 **Randall, M. J.** Relative sizes of multipolar components in deep earthquakes: Jour. Geophys. Research, v. 73, no. 18, p. 6140–6142, illus., table, 1968.

On the focal sphere the wave amplitudes resulting from a deep-earthquake source that involves only volume changes are constant. Thus, by analyzing the amplitudes on the focal sphere, obtained by tracing back the observed amplitudes and making appropriate corrections, the coefficients can be estimated of the six orthogonal surface harmonics of the zero and second degree, the six degrees of freedom associated with those of strain release at the source. Results of an analysis of the Tonga–Fiji earthquake of December 28, 1964, suggest a sudden phase transition mechanism which is not inconsistent with what we know of the deep structure of the region.—DBV

04390 **Rawson, Richard R.** Mississippian carbonate, Montana and North Dakota [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 24, 1968.

04379 **Ray, Clayton E.; Wills, Donald L.; Palmquist, John C.** Fossil musk oxen of Illinois: Illinois Acad. Sci. Trans., v. 61, no. 3, p. 282–292, illus., 1968.

The first definitely identifiable specimens of *Ovibos* from Illinois are reported from Henderson and Fulton Counties. Eleven other locality records, six previously unpublished, for musk oxen in Illinois are reviewed, representing *Symbos*, ovibovines of uncertain generic identity, or possibly non-ovibovine bovids. [The 13 recorded finds include two of *Ovibos*; four, more or less certainly identified, of *Symbos cavifrons*, two questionably referred to *Symbos*, and five of Ovibovini or Ovibovini(?), gen. et. sp. indet.]—Authors' abstract

03990 **Ray, L. L.; Karlstrom, T. N. V.** Theoretical concepts in time-stratigraphic subdivision of glacial deposits, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 115–120, illus., 1968.

Confusion in definition and correlation of time-stratigraphic boundaries in sequences of Quaternary deposits results from lack of uniformity in the establishment of common reference boundaries for dating and correlating type-locality deposits. It is suggested that of the three methods currently in use, that which is most suitable refers the boundaries to stands of sea level and equivalent terrestrial deposits that mark culminations of both major and minor glacial and nonglacial intervals. —Authors' abstract

04076 **Raymahashay, Bikash C.; Holland, Heinrich D.** Composition of aqueous solutions in equilibrium with sulfides and oxides of iron at 350°C: Science, v. 162, no. 3856, p. 895–896, tables, 1968.

Solutions of KCl (pH-buffered and 1-molal) equilibrated at 350°C with pyrrhotite, pyrite, and magnetite contained approximately 1 millimole of reduced sulfur and less than 0.1 millimole of oxidized sulfur per kgm. Similar solutions equilibrated with pyrite, magnetite, and hematite contained approximately 1 millimole of reduced sulfur, but 3 to 6 millimoles of oxidized sulfur per kgm. Both types of solutions contained less than 0.1 millimole of iron per kgm at ph$\geq$6 and approximately 100 millimoles per kgm at pH 2.—Authors' abstract

Rea, Bayard D. *See* Warner, M. A. 04489

04488 **Reed, Bruce L.** Geology of the Lake Peters area, northeastern Brooks Range, Alaska: U.S. Geol. Survey Bull. 1236, 132 p., illus., tables, geol. map, 1968.

A thick series of sedimentary and low-grade metamorphic rocks of Devonian or older to Jurassic age are exposed in the area. Six glacial advances (pre-Wisconsin–Recent), including one advance previously unrecognized in the area, correlate with advances elsewhere in the Brooks Range. Three generations of structural features are recognized. The first generation, resulting from Late Devonian(?) deformation, is represented by broad, open east-southeastward-trending folds with nearly vertical axial planes. Superimposed on first folds are second generation folds consisting of east-southeastward-trending minor folds and south-dipping thrust faults. Third generation features of Laramide age include east-west-trending open folds and east-west-striking high-angle faults. A geologic map and stratigraphic sections are included.—*from* Author's abstract

04425 **Rees, Anthony I.; VonRad, Ulrich; Shepard, Francis P.** Magnetic fabric of sediments from the La Jolla submarine canyon and fan, California: Marine Geology, v. 6, no. 2, p. 145–178, illus., table, 1968.

Measurements of anisotropy of magnetic susceptibility of 24 box cores from La Jolla submarine canyon and fan are compared with magnetic fabrics produced under controlled conditions. Many cores have a fabric similar to that produced during deposition from running water in the laboratory. Most samples from the upper canyon have a 'primary' magnetic fabric characterized by a near horizontal magnetic foliation plane, susceptibility maxima well grouped in this plane and approximately parallel to the canyon axis, and q values about 0.4. Those from the fan-valley and fan show traces of a similar type of fabric. Effects of two types of deformation are distinguished resulting from forces tangential to bedding and the randomizing action of burrowing organisms.—*from* Authors' abstract

04523 **Reesman, R. H.** The Rb-Sr analyses of some sulfide mineralization: Earth and Planetary Sci. Letters, v. 5, no. 1, p. 23–26, illus., table, 1968.

The analyses of sulfide ores reveal that they contain low concentrations of Rb and Sr. The Rb/Sr ratios appear to be adequate for dating these ores.—Author's abstract

Reger, Richard D. *See* Batchelder, George L. 04388

04002 **Reichen, Laura E.; Fahey, Joseph J.** Determination of nitrates in saline minerals: U.S. Geol. Survey Bull. 1214-F, p. F1–F4, table, 1968.

The alkali nitrate is heated in the presence of magnesium sulfate for 40 minutes at 600°C, whereby magnesium oxide is produced in stoichiometric relation to the N_2O_5 present. The amount of magnesium oxide is measured by titration with sulfuric acid, and the equivalent N_2O_5 is calculated.—Authors' abstract

04549 **Rensberger, John Marshall.** Entoptychine gophers of the John Day Formation, Oregon [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 704B, 1968.

Reppmann, E. *See* Degens, E. T. 04440

04490 **Retcofsky, H. L.; Friedel, R. A.** Room-temperature proton magnetic relaxation times in a bituminous coal: Fuel, v. 47, no. 5, p. 391–395, illus., 1968.

Room-temperature proton nuclear magnetic resonance relaxation times have been measured for a vitrain-rich Pittsburgh coal using a pulsed n.m.r. spectrometer. Both the spin-lattice relaxation time and the spin-spin relaxation time were found to be of the order of only several microseconds. These values are much shorter than those typical of non-metallic solids and are thought to be due to a promotion of relaxation processes by the paramagnetic species known to be present in the coal.—Authors' abstract

Rhyner, C. R. *See* Cameron, John R. 03961

04010 **Richards, Horace G.** The Tertiary history of the Atlantic Coast between Cape Cod and Cape Hatteras, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 95–104, illus., 1968.

The erratic displacements of the Tertiary shorelines in this area, both from place to place and with passing time, indicate that tectonics, rather than isostasy or glacio-eustasy, has been the dominant factor in determining the present vertical position of the Tertiary shoreline indicators.—Author's summary

04058 **Richter, Donald H.; Matson, Neal A., Jr.** Distribution of gold and some base metals in the Slana area, eastern Alaska Range, Alaska: U.S. Geol. Survey Circ. 593, 20 p., illus., tables, 1968.

In the Slana area of the eastern Alaska Range, Paleozoic and Mesozoic sedimentary and volcanic rocks have been intruded by dioritic and quartz monzonitic rocks. Stream-sediment and bedrock samples indicate that anomalous concentrations of gold and copper are associated with the dioritic intrusives, and lead-zinc and lead-molybdenum concentrations are related to the Ahtell quartz-monzonite intrusion. Metal concentrations as high as 7 ppm gold, 365 ppm zinc, 250 ppm lead, and 25 ppm molybdenum have been found in the sediments; the distribution of gold in bedrock follows the pattern shown by stream-sediment data. Dioritic rocks from areas drained by streams anomalously high in gold contain up to 0.3 ppm gold. The data suggest that placer gold deposits may be present in streams draining the principal area anomalous in gold and bedrock sources should be evaluated as possible low-grade disseminated gold deposits.—*from* Authors' abstract

Rinehart, C. Dean. *See* Fox, Kenneth F., Jr. 04112

04068 **Risk, M. J.** Shallow-water ripple marks at Pinery Park, Lake Huron, Ontario [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 214, 1968.

04311 **Ritchot, Gilles.** Géomorphologie et géographie: Rev. Géographie Montréal, v. 22, no. 1, p. 69–80, illus., 1968.

The old, difficult question of the position of geomorphology within the scope of the sciences and its relation to geography are discussed. Ritchot concludes that geomorphology is the science of the horizontal organization of relief features of the surface of the Earth, that the structures of geomorphology, contrary to forms considered as isolated features, suggest and permit the formulation of multiple hypotheses. These hypotheses, being multiple, warrant verification; the search for natural factors to identify the processes of organization can take place. The

verification of the hypotheses by analyses of the processes produces explanations equally original and impartial.—HRC

04317 **Rives, John S.** Structural and stratigraphic traps related to extrusive rocks in South Central Texas: South Texas Geol. Soc. Bull., v. 9, no. 1, p. [4–14], illus., 1968.

The primary dome-forming tectonic activity has been differential compaction and draping over very steeply sloping extrusive serpentinite-basalt masses. In many places reefoid development also took place on the crests; these igneous bodies are located in a 250 by 25 mi belt on the downthrown side of the Balcones fault zone, and parallel to it. Upper Cretaceous Austin Chalk was deposited prior to the igneous activity, but the Anacacho Limestone, deposited between periods of volcanism, is a possible reservoir. Cretaceous and Tertiary clastic sediments overlie the domes and are deformed by them; tension and relief faults occur over the crests, and hydrocarbon accumulations occur here and on the flanks in onlap, wedge-out, permeability and fault traps. Production began in the early 1920's, and of the 20 oil and gas fields discovered, at least one has produced 10 million bbl. Many more fields may exist.—ESL

03951 **Roach, Carl H.** Influence of stress history on low-temperature thermoluminescence of halite, Chap. 12.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 591–619, illus., tables, 1968.

Differing thermoluminescence in exposed rocks of same type at quarries, meteor craters, and along large fault systems, lead to study of influence of stress history on thermoluminescence of rock-forming minerals. Thermoluminescence of pre- and post-shot halite cores from nuclear test sites were compared—Salmon site, Tatum salt dome, Miss., and Gnome site, Salado Formation near Carlsbad, N. Mex.—then pre-shot samples were subjected to laboratory tests. Shock-induced TL in homogeneous samples decreases exponentially with distance from point of shock, but interacts with physical irregularities. Stress-induced low-temperature TL of halite appears closely associated with stress domain of plastic deformation, and could be useful in mapping 3-dimensional extent of deformed halite adjacent to underground chemical and nuclear explosions; it might be applied to fields of rock mechanics associated with earthquakes, faults, or metamorphic rocks.—GDC

04032 **Robbins, Stephen L.** Gravity and magnetic data over the Calaveras, Hayward, and Silver Creek faults near San Jose, California [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 216–217, 1968.

04096 **Rodean, Howard C.** Understanding and constructively using the effects of underground nuclear explosions: Rev. Geophysics, v. 6, no. 3, p. 401–445, illus., tables, 1968.

Equations of state for geologic materials are based on geophysical and laboratory measurements, and on theoretical calculations for high-pressure and high-temperature conditions; they are of fundamental importance in describing their response to nuclear explosions. Measurements of ground motion are used with equations of state, chemical and thermodynamic theory, and laws of continuum mechanics to develop mathematical models for predicting phenomena. Postshot exploration gives clues that aid in interpretation of the experiment. Safety considerations include airblast seismic motion, and radioactivity; significant progress has been made in their prediction. The generated seismic waves have been used to determine internal structure of the Earth. Use in the petroleum industry is an example of research now underway.—*from* Author's abstract

04223 **Roedder, Edwin; Heyl, Allen V.; Creel, John P.** Environment of ore deposition at the Mex-Tex deposits, Hansonburg district, New Mexico, from studies of fluid inclusions: Econ. Geology, v. 63, no. 4, p. 336–348, illus., 1968.

Fluid inclusions in fluorite from Mississippi Valley type of deposit show essentially constant filling temperatures in the range 186°–205°C, and salinity increasing from

10 to 17 percent, rather than decreasing (more normal), with time. Solutions were probably slow moving and in thermal equilibrium with wall rocks. "The data do not prove any given theory or origin for the fluids or the deposits, but they do place some limits on possible mechanisms of origin."—WSW

04230 **Roedder, Edwin.** The non-colloidal origin of "colloform" textures in sphalerite ores: Econ. Geology, v. 63, no. 5, p. 451–471, illus., 1968.

Study of growth features of "colloform" sphalerite-wurtzite assemblages indicates that "each of the many textural criteria proposed for recognizing colloidal deposition is shown to be invalid, ambiguous, or inapplicable to these samples, and perhaps also to most other 'colloform' mineral samples." Fluid inclusions from such samples presumably represent the original ore fluid. 'Colloform' texture implies "relatively high supersaturation and hence relatively high nucleation and growth rates, for the temperatures involved." Remarkably uniform, regular compositional microbands in some samples suggest cyclic changes in ore fluid due to dilution by surface waters, and may be annual 'varves'.—WSW

04231 **Roedder, Edwin.** Temperature, salinity, and origin of the ore-forming fluids at Pine Point, Northwest Territories, Canada, from fluid inclusion studies: Econ. Geology, v. 63, no. 5, p. 439–450, illus., 1968.

Freezing temperatures of inclusions in sphalerite (133 determinations) indicate exceedingly saline brines. Filling temperatures (112 determinations) fall in the range 51°–97°C before a pressure correction, presumably small. Ore-forming fluid may contain salts dissolved from evaporites, such as are now found to the south, and range of salinity may reflect variable mixture with fresh water. The elevated temperatures suggest deep circulation. Unless saline brines spread far beyond evaporite basins, driving dense brines up through surface waters in area of low relief is a problem. If fine color banding of sphalerite represents annual "varves", mineral deposition took about 10,000 years.—WSW

04049 **Rogers, Thomas H.; Nason, Robert D.** Active faulting in the Hollister area [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 42; discussion, p. 43–45, 1968.

04428 **Roland, George W.** The system Pb–As–S—Composition and stability of jordanite [with German abs.]: Mineralium Deposita, v. 3, no. 3, p. 249–260, illus., tables, 1968.

Silica-tube quenching and gold-tube pressure experiments are used to study phase relation in the PbS-rich portion of the system Pb–As–S. Emphasis was on determining the P–T–X stability relations of jordanite, the most Pb-rich of the synthetic Pb–As–S compounds. Jordanite is stable below 549 ± 3°C, at which temperature it melts to galena, liquid, and a sulfur-rich vapor phase. Confining pressures of up to 2 kb do not measurably change this temperature. Cell contents and space group are given. Heating experiments on natural gratonite show that this mineral is probably a low-temperature dimorph of jordanite, the inversion occurring below 250°C. Extensive substitution of Sb for As in jordanite is confirmed.—*from* Author's abstract

04384 **Romans, Robert C.** A brief history of paleobotany in Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 8, 1968.

Romans, Robert C. *See* Canright, James E. 04386

03967 **Ronca, L. B.** The thermoluminescence of ice, Chap. 4.5 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 257–266, illus., table, 1968.

Glow-curves in ice, which is about 10,000 times less luminescent than calcite, vary with amount of ultraviolet irradiation or running time. Glow-curves were obtained from fresh and recrystallized snow, frost crystals, crevasse filling, compacted firn, glacier ice with random and aligned bubbles and with shear and flow structures,

and artificially frozen ice. Samples from six localities within a tunnel in the Jungfraujoch ice cap, Switzerland, were tested for effect of pressure, flow, aging and recrystallization upon thermoluminescence of glacier ice. A systematic variation in the −140°C to −190°C peak-height ratio can be related to stress and flow history. Because of difficulty in duplicating lattice imperfections in artificially frozen samples, their glow-curves show wide variation in thermoluminescent characteristics.—GDC

Ronca, Luciano B. *See* Siegel, Frederic R. 03954

04012 **Ronca, Luciano B.** Thermoluminescence as a paleoclimatological tool, Chap. 9.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 495–506, illus., 1968.

Thermoluminescence-producing carriers in the delicate equilibrium of the 230°C peak are discussed; rate of entry is governed by amount of radioactive impurities in the sample, and rate of escape is a function of temperature. In limestones, different lithologies cause differences in transparency and trap density masking other effects; when the same bed is in two different thermal environments, direct comparison can be made. By determining relative thermoluminescence, as described, different samples may be compared. Experimental points are shown with relative natural values of samples from different climatic zones. In relation to the theoretical curve, samples from hot areas have very low relative TL, those from temperate zones have values of 15 percent, those from glaciated areas average 50 percent. In Arctic samples, more ambiguous results suggest a more complicated climatic history than the Antarctic.—GDC

Rose, Harry J., Jr. *See* Cuttitta, Frank. 04274

04275 **Rose, Harry J., Jr.; Cuttitta, Frank.** X-ray fluorescence analysis of individual rare earths in complex minerals: Appl. Spectroscopy, v. 22, no. 5, p. 426–430, illus., tables, 1968.

A combined chemical X-ray fluorescence method is described for determining rare-earth elements in small amounts of complex rare-earth minerals. These elements yield a complex X-ray spectrum in which many analytical emission $L\alpha$ lines of a given element coincide with the $L\beta$ and/or $L\gamma$ lines of a lighter rare-earth element several atomic numbers removed. The proposed analytical scheme corrects for these interferences. Sixteen elements consisting of the lanthanides, yttrium, and scandium can be determined on as little as a 1-mg portion of the separated oxides. The oxides are dissolved in 1 ml of dilute acid, absorbed onto cellulose powder and pressed into a pellet for X-ray excitation. Chemically analyzed geologic standards are not required for calibration.—Authors' abstract

04447 **Rosell, Ramon Antonio.** Some reactions of manganese with montmorillonite and soil organic matter [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2,p. 446B, 1968.

04543 **Rosen, Norman Charles.** Heavy minerals of the Citronelle Formation of the Gulf Coastal Plain [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 661B, 1968.

04199 **Ross, Arnold.** Notes on *Balanus humilis* Conrad, 1846: Florida Acad. Sci. Quart. Jour., v. 30, no. 3, p. 173–176, illus., 1967[1968].

The type specimen described by T. A. Conrad from the upper Eocene limestone of Tampa Bay, cannot be located; it has never been redescribed or refigured, or its true nature determined. The original description, too brief to be of taxonomic value, is repeated. The Tampa Limestone is now assigned an early Miocene age. Based on comparison of Conrad's figure with 20 specimens from the middle and late Miocene, the author concludes that *Balanus humilis* is a phosphatized internal filling of a barnacle shell. There are undoubtedly several species preserved in this manner so that the taxonomic identity is still obscured.—ESL

Ross, C. P. *See* Nelson, W. H. 04109

Rothermel, R. V. *See* Gaede, Verne F. 04418

03997 **Rowe, J. J.; Simon, F. O.** The determination of gold in geologic materials by neutron-activation analysis using fire assay for the radiochemical separations: U.S. Geol. Survey Circ. 599, 4 p., tables, 1968.

In this rapid technique for determining gold at the parts-per-billion concentration level, 1-gram samples are irradiated for ten hours in a flux of 5×10^{12} neutrons per square centimeter per second and are allowed to decay for ten days. The samples are then carried through classical fire-assay separations in the presence of 20 to 50 milligrams of gold carrier, and the 2.7 day Au^{198} is counted in a gamma-ray spectrometer. Forty samples can be processed in eight hours, and a detection limit of 0.05 part per billion gold in a 1-gram sample is attainable.—Authors' abstract

04526 **Roy, Robert F.; Blackwell, David D.; Birch, Francis.** Heat generation of plutonic rocks and continental heat flow provinces: Earth and Planetary Sci. Letters, v. 5, no. 1, p. 1–12, illus., tables, 1968.

Combined radioactivity and heat flow measurements in plutonic rocks at 38 localities define three provinces: the eastern United States, the Sierra Nevada, and a western zone which includes the Basin and Range province. In each province, the heat flow Q, and heat production A, are related by the formula $Q = a + bA$; the radioactivity is apparently constant down to depth b, but varies from place to place, and the fraction of heat flow from the lower crust and upper mantle, a, is constant within a province. Values for a and b are given. The line for the eastern United States is considered the reference curve for normal continental heat flow. Most of the local variation comes from the upper 7–11 km of the crust, the contribution from the upper mantle and lower crust being uniform over large regions. The intercept can be used to interpret mantle contribution.—*from* Authors' abstract

04361 **Runcorn, S. K.** Virtual geomagnetic poles: Jour. Geophys. Research, v. 73, no. 18, p. 6138, 1968.

Runcorn considers inappropriate the term "virtual geomagnetic pole" introduced by Cox and Doell (Geol. Soc. America Bull., v. 71, p. 645–768, 1960) to denote the pole position computed from a set of paleomagnetic observations. Virtual in the dictionary is defined as that which is opposed to real, but the geomagnetic poles or dipoles or axes, whether obtained from present-day magnetic surveys or from remanent magnetism are all mathematical fictions. It should not be necessary to convince geophysicists and others of the provisional nature of scientific hypotheses.—DBV

04312 **Rush, F. Eugene.** Water-resources appraisal of Clayton Valley-Stonewall Flat area, Nevada and California: Nevada Dept. Conserv. and Nat. Resources Water Resources-Reconn. Ser. Rept. 45, 54 p., illus., tables, 1968.

This area in south-central Nevada and southeastern California is composed of six valleys that are parts of three major hydrologic systems that apparently terminate in Clayton Valley, Sarcobatus Flat, and Death Valley. Most of the economically available ground water is stored in the alluvium which comprises the valley-fill reservoir. Evapotranspiration is the dominant type of natural discharge from Clayton Valley; in the other valleys, subsurface outflow generally dominates. Clayton Valley has the highest water-development potential, with 20,000 acre-feet of natural discharge as yet undeveloped. Generally in the other valleys, recharge and subsurface inflow have been reduced.—*from* Author's abstract

Rush, Richard W. *See* Beus, Stanley S. 04393

04091 **Rutter, N. W.** Surficial geology of the Banff area, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 208–209, 1968.

04431 **Ruxton, Bryan P.** Measures of the degree of chemical weathering of rocks: Jour. Geology, v. 76, no. 5, p. 518–527, illus., tables, 1968.

In humid regions, the silica-to-alumina ratios provide a way to quantify the degree of rock weathering. The reliability of this index depends on the uniformity of the bedrock, the constancy of alumina content during weathering, the degree of correlation between silica loss and total-element loss, and on the magnitude of the difference between the silica-to-alumina mole-ratio values of fresh and thoroughly weathered rock. Examination of total silicate analyses of fresh and derivative weathered rocks shows good correlation between silica loss and total-element loss, and between silica-to-alumina mole-ratio and total-element loss. The silica-to-alumina mole-ratio also correlates well with other weathering indices calculated from total silicate analyses.—*from* Author's abstract

04487 **Ryan, J. A.; Grossman, J. J.; Hansen, W. M.** Adhesion of silicates cleaved in ultrahigh vacuum: Jour. Geophys. Research, v. 73, no. 18, p. 6061–6070, illus., table, 1968.

Adhesions between various silicate minerals cleaved in an ultrahigh vacuum (1 to 4×10^{-10} torr) are compared with adhesions between the same minerals cleaved in air at atmospheric pressure. In some tests a single mineral sample was cleaved, and the resulting fresh faces were brought into contact at various orientations. In other tests two samples were cleaved, and faces of the different samples were brought into contact. Adhesion forces as large as 10^4 dynes were observed, and much higher forces shortly after cleavage were indicated. The following conclusions were reached: (1) The surface charging contributes significantly to adhesion, and silicate atomic bonding forces also may be acting. (2) Though surface charging can be produced by random charge separation during cleavage, the major contributors are probably nonuniform stoichiometry and defect structures of the crystalline lattice.—*from* Authors' abstract

Rydell, H. S. *See* Osmond, J. K. 04077

04116 **Rye, Robert O.; Haffty, Joseph.** Chemical composition of the hydrothermal fluids responsible for the lead-zinc deposits at Providencia, Zacatecas, Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 704, 1968.

Rye, Robert O. *See* Ohmoto, Hiroshi. 04153

Rytuba, James J. *See* Foose, Richard M. 04280

Sackett, W. M. *See* Degens, E. T. 04439

04252 **Sainani, U. R.; Pare, J. J.** Geotechnical properties of foundation soils at Outardes 2 project [abs.]: Canadian Geotech. Jour., v. 5, no. 3, p. 174, 1968.

04147 **Salas, Guillermo P.; Folk, Stewart H.** Sulfur deposits of Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 700, 1968.

04513 **Sales, John K.** Crustal mechanics of Cordilleran foreland deformation—A regional and scale-model approach, *in* Rocky Mountains-Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 2016–2044, illus., 1968.

Foreland Rockies deformation was caused by compressive stresses transmitted tangentially through the continental basement and the overlying geosynclinal prism from the Pacific continental margin. Dissipation of these stresses by deformation has altered through time from the continental margin to the foreland, depending on the ability of the geosyncline to transmit the stress. Stress transmission resulting from Late Cretaceous solidification of the batholith caused Laramide breakup of the foreland. The mechanism of formation of structural features in Colorado and Wyoming are described, based in part on model studies.—WCC

04217 **Sandeen, W. M.** Ground-water resources of San Jacinto County, Texas: Texas Water Devel. Board Rept. 80, 90 p., illus., tables, 1968.

Large quantities of undeveloped fresh water extending to depths as great as 1,600 feet are present in San Jacinto County. In 1965, an estimated 1.2 mgd was

withdrawn, more than half from flowing wells. Hydrologic units present are the Jasper aquifer, Burkeville aquiclude, Evangeline aquifer, and Catahoula Sandstone. It is estimated that about 35 mgd could be pumped continually from the Jasper and Evangeline aquifers together, and a smaller amount from deeper sands and the Catahoula. Chemical quality is suitable for most use. About 70 percent of the water used is from the Evangeline, and 25 percent from the Jasper. It is recommended that a continuing program for measuring levels in observation wells be established; and that another for measuring base flow of streams as related to rejected recharge should be developed.—*from* Author's abstract

04265 **Sanford, B. V.; Norris, A. W.; Bostock, H. H.** Geology of the Hudson Bay Lowlands (Operation Winisk, 1967): Canada Geol. Survey Paper 67-60, p. 1-45, illus., geol. map, 1968.

Operation Winisk was an air-supported reconnaissance of the lowlands bordering on Hudson and James Bays, in Manitoba, Ontario, Quebec, and District of Keewatin in N.W.T. The first part of the report presents a summary of the Precambrian and Phanerozoic geology of this area covered by Map 17-1967 (in pocket). Three new formational names—the Stooping River, Kwataboahegan, and Murray Island—are introduced to designate distinctive Devonian rock units mapped in the area. Rocks of Precambrian, Ordovician-Devonian, and Cretaceous ages are described briefly, as are mineral showings and prospects in Precambrian rocks—limestones, gypsum, sideritic iron, lignite, and possibilities of petroleum and natural gas. The second part (Norris), cited separately, is a fairly comprehensive bibliography compiled for the planning of further exploration in the Hudson Bay Lowlands.—GDC

Sanford, B. V. *See* Norris, A. W. 04266

04463 **Sanford, B. V.** Oil and gas in southwestern Ontario, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1798-1818, illus., tables, 1968.

Southwestern Ontario, an area of about 40,000 sq mi, is underlain by marine sedimentary rocks with a maximum thickness of about 5,000 ft. All geologic systems from Cambrian to Mississippian are represented. Both oil and gas have been produced commercially for more than a century; current production is about 1.3 million bbls of oil and 15 million cu ft of gas annually. Production is from 12 stratigraphic zones from the Cambrian through Devonian Systems. Most of the oil produced has been from shallow Devonian strata; gas has been mainly from reservoirs of Silurian age. In recent years, however, more attention has been directed to the prospects of the deeper Ordovician and Cambrian rocks, and about 28 percent of the oil now produced is from these strata.—Author's abstract

Sasaki, A. *See* Chrismas, L. 04138

04547 **Scafe, Donald William.** A clay mineral investigation of six cores from the Gulf of Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 703B, 1968.

Schenk, P. E. *See* Harris, I. McK. 04399

04181 **Schilling, John H.; Garside, Larry J.** Oil and gas developments in Nevada, 1953-1967: Nevada Bur. Mines Rept. 18, 43 p., illus., tables, 1968.

From 1953 through 1967, 124 wells have been drilled in Nevada for oil and gas. Fourteen of these were completed as producing oil wells; gas has not been found in commercial amounts. All the oil wells are in one field—the Eagle Springs field in east-central Nevada—which has produced 1,769,372 bbl of oil through 1967. Exploration has taken place mainly in east-central Nevada, although there has been considerable activity in the southern and northeastern parts of the State. The report gives data on all wells drilled, including production statistics for the producing wells; it also briefly describes the complex geology of the Eagle Springs field.—*from* Authors' abstract

04417 **Schmidt, Robert George; Strong, Ceylon P., Jr.** Preliminary geologic map of the Roberts Mountain quadrangle, Lewis and Clark County, Montana: U.S. Geol. Survey Misc. Geol. Inv. Map I-564, scale 1:24,000, section, 1968.

04395 **Scholtz, Judith Fessenden.** Structural geology of the Woods Canyon drainage basin, Coconino County, Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 26, 1968.

Schoustra, Jack J. *See* Scott, Ronald F. 04344

04459 **Schroeder, Warren Lee.** Liquefaction of saturated sands [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 601B, 1968.

04548 **Schubel, Jerry Robert.** Suspended sediment of the northern Chesapeake Bay [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 703B–704B, 1968.

04283 **Schumm, S. A.** Speculations concerning paleohydrologic controls of terrestrial sedimentation: Geol. Soc. America Bull., v. 79, no. 11, p. 1573–1588, illus., table, 1968.

Review of phytologic, hydrologic, and geomorphic data permits speculation on the effect of changes in plant cover on fluvial sedimentary deposits throughout geologic time. During Precambrian and early Paleozoic time, before the appearance of significant plant cover, denudation and runoff rates were high and coarse sediments were spread as sheets over piedmont areas; during late Paleozoic and early Mesozoic time the land surface was colonized by primitive plants and alluvial deposits were stabilized, but periodic large floods flushed the system and created cyclic sedimentary deposits; during Mesozoic and early Cenozoic time hardier and more modern plants evolved, interfluve areas were vegetated, and sediment yield generally decreased; during late Cenozoic time grasses appeared and runoff conditions and erosion similar to those of the present prevailed.—HCW

04430 **Schwartz, Maurice L.** The scale of shore erosion: Jour. Geology, v. 76, no. 5, p. 508–517, illus., table, 1968.

Size and time are functionally related to scale of shore erosion by $S = f(A_e, T_e)$, where S is the scale, A_e the equilibrium amplitude, and T_e the equilibrium time. Equilibrium amplitude is the vertical variation of profile translation required to restore equilibrium; equilibrium time is the period required. Scales in shore erosion are designated as: (1) microscale, representing the swash–backwash zone (mean vertical variation 10 cm, mean period 10 min); (2) macroscale, representing neap–spring or seasonal cycles (mean vertical variation 10^2 cm, mean period 10^4–10^5 min); (3) megascale, representing long-term changes in sea level (vertical variation on the order of 10^3–10^4 cm, period 10^9–10^{10} min). The correlation between the equilibrium amplitude and the equilibrium time suggests the universality of the Bruun effect.—Author's abstract

04159 **Scott, Glenn R.; MacCary, Lawrence M.** Geologic map of the Hardin quadrangle, Marshall County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-759, scale 1:24,000, section, text, 1968.

Economic deposits in the Hardin quadrangle include: (1) gravel suitable for road metal, in upland areas commonly 40 feet thick and accessible from roads; (2) clay, possibly of ceramic quality, in the Porters Creek Clay and as lenses in the Clayton and McNairy Formations; and (3) ground water suitable for domestic use in wells from 10–360 feet deep; 450 gpm is available from basal sand beds of the Clayton and McNairy Formations, and water for domestic and commercial use is obtained from large-diameter wells in alluvium.—MCM

04344 **Scott, Ronald F.; Schoustra, Jack J.** Soil mechanics and engineering: New York, McGraw-Hill Book Co., 314 p., illus., tables, 1968.

Topics in this first-course textbook in mechanics and engineering of soils have been presented with a minimum of mathematical development. The aim of the book is to demonstrate that theoretical and practical soil mechanics are well matched

to solve everyday soil-engineering problems. Part 1, physics and mechanics of soils is divided into: nature of soils, water in soil, stresses acting in soils, seepage and consolidation, shearing strength of soils, and failure of soils. In part 2, soil engineering in practice, chapter headings are: exploration of soil conditions in the field, foundations, retaining structures, soil drainage and dewatering, and soil property modification and pavement design.—MCM

04500 **Seeger, C. Ronald.** Origin of the Jeptha Knob structure, Kentucky: Am. Jour. Sci., v. 266, no. 8, p. 630–660, illus., tables, 1968.

A magnetic survey of Jeptha Knob showed there is probably no basement counterpart of the surface structure. A gravity survey revealed a +1 mgal anomaly which can be explained by near-surface lithologies. Drilling indicates that the deformation decreases with depth and is shallow, and petrologic and structural data eliminate an endogenetic origin. The most likely exogenetic origin is hypervelocity impact of a meteorite or comet. A model of the original Jeptha Knob crater was constructed with the following dimensions: apparent diameter 6,600 feet; apparent depth 920 feet; rim height 290 feet; rim width 1,300 feet; depth to the limit of major brecciation 1,600 feet. This crater was subsequently filled and covered by sediments; the filling material was mainly fallback and slumped materials from the sides.—*from* Author's abstract

04208 **Seeland, David A.** Geologic map of part of the Repton quadrangle in Crittenden County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-754, scale 1:24,000, section, text, 1968.

Fluorspar exploration in the Repton quadrangle has been confined to bedded deposits and vein deposits associated with faults. Estimated coal reserves are 0.8 million short tons, all in the No. 1-b coal. Limestone was produced from one quarry in 1966.—MCM

04471 **Seki, H.; Skelding, J.; Parsons, T. R.** Observations on the decomposition of a marine sediment: Limnology and Oceanography, v. 13, no. 3, p. 440–447, illus., 1968.

The decomposition of organic material deposited in a small bay has been investigated [experimentally]. With a marine species of *Pseudomonas* as an assay organism, material deposited during summer and during winter were both actively decomposed. However, differences in the two types of sediment were apparent from the quantities of nutrients and carbohydrate available to the assay organism, as well as to the antibiotic activity of the two sediments. From calculations on the *in situ* nutrient and carbon budget for the sediment in the same area, nitrogen was regenerated most rapidly, followed by phosphorus and carbon. The rate of sediment decomposition, determined as the ratio of the input of material to the steady-state level in the sediment, is suggested as a basis for the biological comparison of near-shore marine sediments.—Authors' abstract

Selby, K. G. *See* Stermac, A. G. 04258

04427 **Sharma, Ghanshyam D.** Artificial diagenesis in quartz sand and carbonate rocks [with German abs.]: Mineralium Deposita, v. 3, no. 3, p. 232–241, illus., tables, 1968.

Experimental studies of diagenetic changes in carbonates and sand through injection of sea water show that such changes can be reproduced under laboratory conditions. Techniques are described. Results indicate that rim cementation and grain growth take place early in diagenesis and can be simultaneous in carbonate rock; chemical diagenesis in sediments is controlled significantly by chemical composition of the contained fluids, and significant diagenetic changes take place during early stages of burial.—VSN

04023 **Sharp, Robert V.** The San Andreas fault system and contrasting pre-San Andreas structures in the Peninsular Ranges of southern California [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 292–293, 1968.

04409 **Sharpe, J. I.** (compiler). Mineral deposits map of the Rouyn–Noranda area: Quebec Dept. Nat. Resources Map 1653, scale 1:63,360, 1968.

Shelburne, O. B. *See* Warner, M. A. 04489

Shen, William C. *See* Kutzbach, John E. 04171

Shepard, Francis P. *See* Rees, Anthony I. 04425

04552 **Shepard, Francis P.; Buffington, Edwin C.** La Jolla submarine fan–valley: Marine Geology, v. 6, no. 2, p. 107–143, illus., table, 1968.

The submarine fan built into San Diego Trough off La Jolla, Calif., is creased by a steep–sided valley that "hooks" left, as do most fan–valleys off the western United States. Detailed contouring on the basis of sounding lines has revealed complex natural levees, continuous along the right bank of the valley but poorly developed along the left except for the outer third. Terraces are well developed in the central portion adjacent to the inner channel, are intermittent and at variable heights in the middle portion, and are inconspicuous along the outer valley; a landslide origin seems probable. The valley lacks distinct distributaries, although remnants may exist along the outer part. Precipitous walls on outer bends and clean sands under a thin mud layer indicate active erosion still intermittently in progress.—*from* Authors' abstract

Sheridan, Michael F. *See* Foose, Richard M. 04280

04398 **Sheridan, Michael F.** Caldera structures between the Goldfield Mountains and Superstition Mountains, Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 27, 1968.

Shor, George G., Jr. *See* Normark, William R. 04286

04299 **Shreve, Ronald L.** The Blackhawk landslide: Geol. Soc. America Spec. Paper 108, 47 p., illus., geol. map, 1968.

The prehistoric Blackhawk landslide in southern California has peculiarities common to historic landslides, and in lithology, size, and 'coefficient of friction,' strongly resembles many monolithologic breccia deposits of possible landslide origin found with Tertiary faults and fanglomerates. Geological evidence and eye–witness reports suggest the Blackhawk slide and its congeners started as huge rock falls, were launched into the air, and then traversed gently inclined, relatively smooth slopes below as nearly nondeforming sheets of breccia sliding at high speed on a relatively thin, easily sheared lubricating layer. The facts suggest these slides acquire such high speed in their descent that at sudden steepening of slope they leave the ground, overriding and compressing a cushion of trapped air upon which they cross gentler slopes below with little friction; many puzzling details of form and structure are explained by this air–layer lubrication.—MST

Shrewsbury, R. D. *See* Moore, B. J. 04106

04254 **Shurbet, D. H.** Upper–mantle structure beneath the margin of the Gulf of Mexico: Geol. Soc. America Bull., v. 79, no. 11, p. 1647–1649, illus., 1968.

Seismograms of S–phases recorded at Lubbock, Texas, from earthquakes near the Texas–Louisiana border are nearly identical to the S–phases recorded at Bermuda which are diagnostic of oceanic upper–mantle structure. The Lubbock S–phases are unlike those diagnostic of continental structure; therefore, they may indicate extensive sedimentary filling of the Gulf of Mexico over oceanic upper mantle or oceanic crust.—AG

03954 **Siegel, Frederic R.; Vaz, J. Eduardo; Ronca, Luciano B.** Thermoluminescence of clay minerals, Chap. 12.3 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 635–641, illus., tables, 1968.

To investigate thermoluminescence of archeological clay materials before firing, standard clay minerals were selected from kaolinites, including halloysite and dickite; illites; and montmorillonites, including bentonite, metabentonite, and hectorite. Observed natural and artificially-induced peaks are tabulated, and glow-curves are illustrated. In all cases gamma irradiation caused peak shifts to lower temperatures, which may be due to retrapping or to relative changes in light emitted from mineral impurities. Wide variety in crystal structure, degree of crystallinity, and chemical impurities makes difficult the identification of clay minerals on the basis of thermoluminescence. In general kaolinite loses its crystallinity when fired, and this may be true for certain montmorillonoids; illite will retain its micaceous character in anhydrous modification. Additional traps other than radioactive ones must be considered in age determination of pottery shards.—GDC

Siesser, William G. *See* Bradford, Douglas E. 04333

04018 **Silver, Leon T.** Pre-Cretaceous basement rocks and their bearing on large-scale displacements in the San Andreas fault system [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 279; discussion, p. 280, 1968.

04073 **Simmons, Gene; Nur, Amos.** Granites—Relation of properties in situ to laboratory measurements: Science, v. 162, no. 3855, p. 789–791, illus., table, 1968.

The velocity of compressional waves and electrical resistivity in granite in place measured in two 3-km boreholes exhibits very little variation with depth, in contrast with the variation predicted from laboratory measurements on dry samples. These observations can be explained either by the absence of small open cracks in the rocks in place or by the effects of complete saturation with water. The seismic velocities of many granites at shallow depths in the Earth's crust may be significantly larger than was previously believed. Other properties are also affected; correction for the effect of cracks on thermal conductivity raises the average heat flow in shield areas by as much as 20 percent.—Authors' abstract

Simon, F. O. *See* Rowe, J. J. 03997

Simonson, G. H. *See* Parsons, R. B. 04192

04304 **Simpson, Dale R.; Fergus, John H., Jr.** The effect of water on the compressive strength of diabase: Jour. Geophys. Research, v. 73, no. 20, p. 6591-6594, illus., table, 1968.

The compressive strength of water soaked diabase is found to be about 60 percent of that of diabase dried at temperatures greater than 190°C. Several solvents other than water failed to cause a decrease in the strength of diabase. This suggests that water is involved in a chemical reaction during the fracturing process, and that its effect is not simply capillary action.—Authors' abstract

04000 **Siple, George E.** Memorandum report on impact of proposed canals on ground-water regimen of Berkeley and Charleston Counties, S. C., *in* Cooper River, South Carolina (shoaling in Charleston Harbor): U.S. Cong., 90th, 2d sess., Senate Doc. 88, p. 153–160, illus., 1968.

The area is underlain by Eocene–Pleistocene clastic and calcareous deposits extending to several hundred feet below sea level. The Tertiary formations dip to the south and southwest. There are at least two and probably three principal aquifers. From the very limited amount of data available, the impact of the projected canals is not considered to be detrimental to the ground-water regimen except that some indeterminate amount of water-level decline and flooding and a questionable possibility of salt-water intrusion is likely to follow.—ESL

04303 **Six, David A.** Red Oak-Norris gas field, Brazil anticline, Latimer and LeFlore Counties, Oklahoma, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age. Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1644–1657, illus., 1968.

The Red Oak–Norris gas field is in the deeper part of the Arkoma basin, the gas coming from the lower Atoka Spiro Sand. The field is unique in that gas also is produced from the middle Atokan Red Oak Sand. This is the largest single gas-producing field in the deep Arkoma basin, and is probably the most complexly faulted. Overthrust faulting from the south as well as both normal down-to-the-north and down-to-the-south faulting are evident.—HRC

Skelding, J. *See* Seki, H. 04471

04272 **Skinner, H. C. W.** X-ray diffraction analysis techniques to monitor composition fluctuations within the mineral group—Apatite: Appl. Spectroscopy, v. 22, no. 5, p. 412–414, tables, 1968.

Hydrothermal synthesis studies in portions of the system $CaO-P_2O_5-H_2O-CO_2-F$ have produced apatites with composition variations. The lattice constants of the apatites have been determined using computer analyses of X-ray powder diffraction data. By this method compositional fluctuations of a phase within a mixture containing several phases can be monitored. Lattice characteristics of hydroxyapatite (molar $CaO/P_2O_5 = 3.3$) synthesized at pressures of 2,000 bars and temperatures from 300° to 800°C from bulk compositions over the range 2.0 to 5.0 CaO/P_2O_5 are discussed.—Author's abstract

04179 **Sleeper, Elbert L.** A new fossil weevil from Nevada (Coleoptera: Curculionidae): Southern California Acad. Sci. Bull., v. 67, pt. 3, p. 196–198, illus., 1968.

Rhyncolus kathrynae, n.sp., is described from Pliocene beds of Hemphillian age (Venturian–Hazen Flora of Axelrod), at Fernley, Nev. (east of Reno). The well-preserved holotype, in place in a burrow in a fossilized pine branch, is the first fossil snoutbeetle from Nevada and the first fossil of the genus and of the tribe Rhyncolini known from North America. The species is closely related to the modern *R. brunneus*, which burrows in *Pinus ponderosa* and *P. jeffreyi*.—VMJ

04193 **Smeck, Neil E.; Wilding, L. P.; Holowaychuk, N.** Genesis of argillic horizons in Celina and Morley soils of western Ohio: Soil Sci. Soc. America Proc., v. 32, no. 4, p. 550–556, illus., tables, 1968.

Variation in the mode and magnitude of development of argillic horizons in Celina and Morley soils must result from differences in texture and carbonate content of parent Wisconsin-age till deposits since other soil-forming factors are similar. The difference in Bt/C clay ratios is due to carbonate dilution of clay in C horizons and by a slightly larger clay gain in Celina Bt horizons. Celina Bt horizons show evidence of montmorillonite whereas Morley do not. In Celina sola and to a lesser degree in Morley sola, upper Bt horizons are actively being degraded whereas lower Bt horizons are gaining clay by illuviation.—Soil Brief

04219 **Smirnov, V. I.** The sources of ore-forming material: Econ. Geology, v. 63, no. 4, p. 380–389, illus., tables, 1968.

Three groups of sources of ore matter are: (1) juvenile, related to subcrustal basaltic matter; deposits of Fe,Mn,V,Ti,Cr,Pt,Cu, and Zn in direct or close association with parent igneous rock, and with compositions similar irrespective of ore province; (2) assimilated, related to palingenetic granitic magma of crustal origin; these deposits (Sn,W,Be,Li,Nb,Ta) are less closely related to parent rocks and less uniform from province to province; (3) filtrational, involving circulation of nonmagmatic underground waters, e.g., telethermal suites. Deposits from juvenile sources belong to the early stage of geosynclinal development and are in and adjoining the troughs; crustal deposits are formed in central uplifts of geosynclinal belts during intermediate and late stages; telethermal deposits are typical of late geosynclinal or platform stages. Isotopic compositions of minerals in juvenile deposits have narrow ranges, in crustal deposits larger ranges, in telethermal deposits maximum ranges.—WSW

Smith, E. L. *See* Boyce, R. E. 04426

03975 **Smith, G. I.** Late-Quaternary geologic and climatic history of Searles Lake, southeastern California, *in* Means of correlation of Quaternary successions—

Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 293–310, illus., 1968.

Radiocarbon dates relate some of the lake sediments to glacial stages. The deposits suggest that the prevailing climates of some interpluvial periods differed from those of other periods in their seasonal distribution of precipitation. Early Wisconsin time began 100,000 years ago, and the lake filled to overflowing two or more times. The saline layers suggest wet summers and dry winters. During middle Wisconsin time seven recessions alternated with six high stands. During the late Wisconsin, the lake was large and probably overflowed, but no salines were deposited during the recessions, indicating a climate similar to the present. A small lake occupies the basin during Recent time.—*from* Author's abstract

03999 **Smith, Joseph B.; Stinson, Donald L.** Mineral resources at Mt. Carbon Reservoir site on Bear Creek, South Platte River basin, Jefferson County, Colo., *in* Bear Creek basin, South Platte River and tributaries, Colorado, Wyoming, and Nebraska: U.S. Cong., 90th, 2d sess., Senate Doc. 87, p. 145–165, illus., table, 1968.

The proposed Mt. Carbon Dam site is on Bear Creek about seven miles above its junction with South Platte River. The stratigraphic section includes Permian–Paleocene rocks, and the Golden thrust fault crosses the project area just west of the sediment pool. The dam and sediment pool would cover less than one percent of the sand and gravel reserves in the Denver area. Both abutments of the dam would be over abandoned coal mines, and the extent and condition of the workings should be investigated. Two active and two inactive sand and gravel pits, five other abandoned coal mines, and one abandoned clay pit would be inundated; some pits can be mined during low water. Flooding of this site would not interfere with oil or gas development in the one well Soda Lakes field.—ESL

04001 **Smith, Joseph B.; McIlroy, Paul.** Mineral resources at 21 reservoir sites on Papillion Creek and tributaries, Douglas, Sarpy, and Washington Counties, Nebr., *in* Papillion Creek and tributaries, Nebraska: U.S. Cong., 90th, 2d sess., House Doc. 349, p. 159–165, illus., 1968.

The Papillion Creek watershed is a broad, Quaternary-age, loess-mantled, upland drift plain, into which broad valleys have been eroded. The thickness of Pleistocene sediments ranges from 30 to 175 feet. There are no known mineral resources that would be affected by the proposed reservoirs. Primary effects would be: regulation of floods in the lower reaches where several processing plants and industries are located; relocation of pipelines, storage tanks, and a pumping plant; and additional protection for rail and truck routes.—ESL

Smouse, DeForrest. *See* Beus, Stanley S. 04393

Smylie, D. E. *See* McFadden, C. P. 04491

04411 **Soister, Paul E.** Geologic map of the Corral Bluffs quadrangle, El Paso County, Colorado: U.S. Geol. Survey Geol. Quad. Map GQ-783, scale 1:24,000, section, text, 1968.

Subbituminous coal beds in the Corral Bluffs quadrangle occur in the upper member of the Laramie Formation, ranging in depth from zero to about 1,500 feet. A few sand and gravel pits in the Nussbaum Alluvium have been worked intermittently for road metal; this formation and alluvial sand and gravel of Nebraskan(?) or Aftonian(?) age could be important sources for construction material. Ground water is essential because of absence of perennial streams or of municipal water supplies. In the west half, sandstone beds of pre-Quaternary formations are generally the only sources of ground water, and probably no large amounts are available. In the east half, Pleistocene sand and gravel comprise the main subsurface water source; however, the water table is near the bottom of these deposits. Oil and gas may be present.—MCM

04486 **Spetzler, Hartmut; Anderson, Don L.** The effect of temperature and partial melting on velocity and attenuation in a simple binary system: Jour. Geophys. Research, v. 73, no. 18, p. 6051–6060, illus., 1968.

A possible explanation of the low-velocity, low-Q zone in the upper mantle is partial melting. This paper reports results of measurements of longitudinal and shear velocities and attenuations in a simple binary system ($NaCl$–H_2O) that is completely solid at low temperatures and involves 17 percent melt at the highest experimental temperature. At temperatures below the eutectic the material is a solid mixture of ice and $NaCl{\cdot}2H_2O$. At higher temperatures the system is a mixture of ice and NaCl brine. In the completely solid regime the velocities and Q change slowly with temperature. There is a marked drop in the velocities and Q at the onset of melting. These results indicate that sharp discontinuities should be expected in velocity and Q where the geotherm crosses the solidus.—*from* Authors' abstract

04372 **Springer, D.; Denny, M.; Healy, J.; Mickey, W.** The Sterling experiment—Decoupling of seismic waves by a shot-generated cavity: Jour. Geophys. Research, v. 73, no. 18, p. 5995–6011, illus., tables, 1968.

The Sterling experiment was detonated at 380 tons of nuclear yield in the Salmon shot-generated cavity on December 3, 1966, at 0615 CST. Sterling data from several seismic stations that had previously recorded Salmon signals are interpreted to give values of the decoupling of seismic waves. Decoupling is deduced as a function of frequency for shot-generated cavities operated at the yield level for Sterling and the yield level for Salmon (5.3 kT). Decoupling ratios were inferred on the basis of a first-power scaling law of amplitude versus yield. A value of 70 ± 20 is seen for the two yield levels at 1 to 2 cps, but this value reduces in different oscillatory ways to 40 or less above 15 cps. A similar function for 5.3 kT in a mined cavity is derived, which shows decoupling values of about 120 at 1 to 3 cps and values less than 10 to 15 cps. The deduced body-wave magnitude for Sterling is 1.35.—*from* Authors' abstract

03956 **Stanford Univ. School Earth Sci.; U.S. Geological Survey; Dickinson, William R.; Grantz, Arthur.** (editors). Proceedings of conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967: Stanford Univ. Pubs. Geol. Sci., v. 11, 374 p., illus., tables, 1968.

The conference on geological and related geophysical and geodetic problems of the fault system, held at Stanford University, Sept. 14–16, 1967, was sponsored by the School of Earth Sciences of the University and the National Center for Earthquake Research of the U.S. Geological Survey. The 43 papers, 17 of which are abstracts, are arranged by subject; all are cited separately. A map showing historically and recently active faults in the California region is included.—ESL

04516 **Steiny, Homer.** John Roy Pemberton (1884–1968): Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 2059–2060, portrait, 1968.

04258 **Stermac, A. G.; Devata, M.; Selby, K. G.** Unusual movements of abutments supported on end-bearing piles [with French abs.]: Canadian Geotech. Jour., v. 5, no. 2, p. 69–79, illus., table, 1968.

Between Cornwall, Ontario, and the Quebec border, in the St. Lawrence River lowland, limestone bedrock of the Chazy, Trenton and Black River formations is covered by glacial till of varying thickness, overlain by Leda clays of the Champlain Sea, in which weathering and desiccation have developed a stiff upper crust. Excessive settlements are not unusual, but at seven underpasses on the MacDonald-Cartier Freeway, abutments moved away from the bridge in such magnitude that extensive repair was necessary. Such movements are explained by variations in thickness of compressible clays and by horizontal force in a direction opposite to that used in conventional design. The thickest layers are found where most severe settlements required repositioning of tilted bearings; maintenance by adding fill or asphalt only increased subsidence and tilt. Duration of consolidation varies with permeability of the subsoil.—GDC

04055 **Stewart, Samuel W.** Preliminary comparison of seismic traveltimes and inferred crustal structure adjacent to the San Andreas fault in the Diablo and Gabilan Ranges of central California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 218–229, illus.; discussion, p. 230, 1968.

Two crustal seismic-refraction profiles parallel and adjacent to the San Andreas fault were established in June 1967, each line about 200 km long with five shotpoints. The Franciscan Formation in the Diablo Range is characterized by a northwest-dipping layered structure, with velocities from 3.3±0.1 to 5.7 kmps with increasing depth; its bottom is placed at 10–16 km, and base of the crust at 30–32 km. Seismic-amplitude attenuation as a function of distance in granitic rocks of the Gabilan Range is quite large, proportional at least to the inverse sixth power of distance in the range 40 to 75 km. If this is a crustal low-velocity zone, then it begins at a depth of no more than 10 km. Total crustal thickness beneath Diablo Range may be a few kilometers greater than beneath Gabilan Range, but it is not possible to state in what manner crustal thickening takes place.—*from* Author's abstract

Stinson, Donald L. *See* Smith, Joseph B. 03999

Stone, Ronald W. *See* Woodriff, Ray. 04271

04070 **Stott, D. F.** Cretaceous stratigraphy between Tetsa and La Biche Rivers, northeastern British Columbia: Canada Geol. Survey Paper 68-14, 41 p., illus., 1968.

Lower Cretaceous rocks between Tetsa and La Biche Rivers in northeastern British Columbia lie unconformably on Triassic to Mississippian sediments. They comprise a thick succession of intertonguing deltaic and marine sandstones and shales, and grade transitionally upward into the alluvial and deltaic conglomeratic sandstone of the Dunvegan Formation. A hiatus representing all of Turonian and probably all of Coniacian time separates those beds from the overlying upper Cretaceous marine shales of the Kotaneelee Formation and a younger succession of alluvial and deltaic sediments included in the Wapiti Formation.—Author's abstract

04285 **Strangway, David W.; McMahon, B. E.; Larson, E. E.** Magnetic paleointensity studies on a Recent basalt from Flagstaff, Arizona: Jour. Geophys. Research, v. 73, no. 22, p. 7031–7037, illus., tables, 1968.

The strength of the ancient magnetic field as recorded in Recent basalts from the SP crater in Arizona has been determined. Three usable samples gave a value of 0.56±.02 oe, in reasonable agreement with archaeomagnetic studies which indicate that the field in this area has changed by a factor of less than 1.5 in the last 2,000 years. Heating samples to 800°C provides criteria for determining which samples are suitable for paleointensity studies. Samples that are initially highly oxidized tend to have only small magnetic changes on heating to 800°C, whereas unoxidized samples change drastically as shown by the changes in the strength of TRM, the stability of TRM, and the character of the hysteresis loops. Microscopic studies suggest that this change is due to the development of extensive lamellas, which lead to increased magnetic stability.—Authors' abstract

04341 **Strimple, Harrell L.; Strimple, Melba L.** Pennsylvanian *Synbathocrinus* from Oklahoma: Oklahoma Geology Notes, v. 28, no. 5, p. 172–173, illus., 1968.

A specimen of *Synbathocrinus melba* was recovered from a shale above the Torpedo Sandstone Member of the Pennsylvanian Wann Formation near Bartlesville. The specimen is figured, even though it is incomplete, because of the rarity of the form; only the monotype, from the same locality, was known previously in North America.—ESL

Strimple, Melba L. *See* Strimple, Harrell L. 04341

Strong, Ceylon P., Jr. *See* Schmidt, Robert George. 04417

04062 **Stuiver, Minze.** Oxygen-18 content of atmospheric precipitation during last 11,000 years in the Great Lakes region: Science, v. 162, no. 3857, p. 994–997, illus., 1968.

Freshwater lake marl and mollusks from Indiana show variations in ratios of O-18 to O-16 of a few per mil during the Postglacial. For the last 9,000 years these variations are about 1 per mil for properly selected lake sediments. Thus the oxygen

isotope composition of atmospheric precipitation appears relatively stable over this interval, indicating stationary atmospheric circulation patterns over the Great Lakes region. A reduction in 0–18 content around 10,000 years ago corresponds with the climate change indicated by pollen profiles. Large systematic differences were found between C–13 and 0–18 content of marl and mollusks.—Author's abstract

04201 **Stumm, Erwin C.** Two unusually well-preserved trilobites from the Middle Devonian of Michigan and Ohio: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 2, p. 33–35, illus., 1968.

The holotype of *Dechenella (Basidechenella) witherspooni* n.sp. is described from the Alpena Limestone of Michigan, and a beautifully preserved specimen of *Dechenella (Basidechenella) lucasensis* Stumm is described from the Silica Shale of Ohio. Author's abstract

04202 **Stumm, Erwin C.** The corals of the Middle Devonian Tenmile Creek Dolomite of northwestern Ohio: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 3, p. 37–44, illus., 1968.

The Tenmile Creek Dolomite is a very poorly exposed formation overlying the Silica Shale in Lucas County, Ohio. The rugose coral fauna includes one species of *Heterophrentis*, two of *Heliophyllum* (one new), one new species of *Zonophyllum*, one species of *Cystiphylloides*, one new species of *Tabellaephyllum*, and one species each of *Bethanyphyllum*, *Eridophyllum*, *Billingsastrea*, *Disphyllum*, and *Depasophyllum*. The tabulate corals include four species of *Favosites* and one of *Aulocystis*.—Author's abstract

Sturges, F. C. *See* Lundgren, Raymond. 04319

04173 **Suess, Hans E.** Climatic changes, solar activity, and the cosmic-ray production rate of natural radiocarbon, *in* Causes of climatic change—INQUA–NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 146–150, illus., 1968.

Fluctuation of the level of radiocarbon in atmospheric carbon dioxide is due to changes in cosmic-ray intensity. These changes can be explained by modulation of the galactic cosmic-ray flux by the sun. A second independent correlation of fluctuations of radiocarbon level with changes in climate can best be recognized from quantitative climatic data since the 10th century A.D. (H. H. Lamb, 1961, 1965). The C–14 measurements so far carried out show that prolonged high solar activity leads to warm winters, and periods of a quiet sun lead to cold winters in Europe and elsewhere. Future determinations of C–14 variations during the past 6,000–8,000 years may supply conclusive evidence regarding the cause for the great ice ages.—*from* Author's abstract

03992 **Suggate, R. P.** Problems of correlation between northern and southern hemisphere glacial sequences, *in* Means of correlation of Quaternary successions—Internat. Assoc. Quaternary Research, 7th Cong., USA, 1965, Proc., V. 8: Salt Lake City, Utah, Univ. Utah Press, p. 151–160, 1967.

Long-range correlations can be no better than the data on which the sequences to be correlated are based. If it is accepted that climatic changes in the northern and southern hemispheres have been synchronous, it should be possible eventually to establish detailed correlations. It is essential that the criteria for distinguishing between interglacial and interstadial intervals should be standardized. The difficulties are exemplified by considering the status of the main interstadial in the "last" glacial, as this could perhaps be recognized as an interglacial in "non-classical" regions.—Author's abstract

04358 **Swanson, H. E.; McMurdie, H. F.; Morris, M. C.; Evans, E. H.** Standard X-ray diffraction powder patterns: U.S. Natl. Bur. Standards Mon. 25, sec. 6, 97 p., illus., tables, 1968.

Standard patterns are presented for 60 substances, 54 representing experimental data and six calculated. Experimental powder patterns are made with a Geiger counter

X-ray diffractometer, using samples of high purity. All d-values were assigned Miller indices determined by comparison with theoretical interplanar spacings and from consideration of space group extinctions. Densities and lattice constants were calculated, and refractive indices were measured whenever possible. The calculated patterns were obtained from published crystal structure data. The reported peak height intensities for calculated patterns were converted from integrated intensities. Reference intensity values based on the strongest line of corundum in a 50 weight percent mixture are given for 98 materials.—*from* Authors' abstract

Swanson, Nancy Peake. *See* Hall, John W. 04527

Sykes, Lynn R. *See* Isacks, Bryan. 04365

04434 **Sylvester, A. G.; Christie, J. M.** The origin of cross-girdle orientations of optic axes in deformed quartzites: Jour. Geology, v. 76, no. 5, p. 571–580, illus., 1968.

In the metamorphic aureole of the Papoose Flat granitic pluton, Inyo Mtns., Calif., progressive flattening of sedimentary rocks is accompanied by recrystallization and development of foliation, lineation, and preferred orientation of minerals, all of which occurred during emplacement of the pluton. In the quartzites the quartz *c* axes are typically oriented in two nearly perpendicular planes that are symmetrically inclined to the foliation and intersect in the foliation perpendicular to the prominent lineation. The symmetry of the patterns is orthorhombic, the foliation and lineation being, respectively, a plane and axis of symmetry. Stratigraphic thinning, distorted fossils, and boudin geometry indicate that the strain involved flattening perpendicular to the foliation and elongation parallel to the lineation.—*from* Authors' abstract

Sylvester, Robert O. *See* Campbell, Thomas H. 04338

Syono, Yasuhiko. *See* Kushiro, Ikuo. 04485

04190 **Tabatabai, M. A.; Hanway, J. J.** Some chemical and physical properties of different-sized natural aggregates from Iowa soils: Soil Sci. Soc. America Proc., v. 32, no. 4, p. 588–591, illus., tables. 1968.

This study presents data concerning different chemical and physical properties of various-sized undried aggregates from seven surface soils and seven subsoils from Iowa. There was little or no difference in exchangeable K, extractable P, pH, or the percentages of sand, silt, or clay in the different-sized aggregates from any one soil sample. In some soils, organic carbon content tended to increase, and bulk density tended to decrease as the aggregate size decreased. The bulk densities of the aggregates were inversely related to the percentages of organic carbon in the aggregates.—Authors' abstract

04435 **Talbot, J. L.; Hobbs, B. E.** The relationship of metamorphic differentiation to other structural features at three localities: Jour. Geology, v. 76, no. 5, p. 581–587, illus., 1968.

Layering of metamorphic origin which cuts recognizable bedding is described from slates, phyllites, and andalusite mica schists. The layering may be parallel to slaty cleavage or crenulation cleavage, or may be independent of any recognizable planar tectonic structure. In most examples, the development of metamorphic layering is associated with heterogeneous strain, but in some cases no heterogeneity is observed. In no instance is there any evidence that the observed metamorphic differentiation resulted in an accentuation of original bedding.—Authors' abstract

04484 **Tamrazyan, Gurgen P.** The earthquakes of Nevada (USA) and the tidal forces: Jour. Geophys. Research, v. 73, no. 18, p. 6013–6018, illus., 1968.

The earthquake origination time in Nevada reveals a close connection with variations of time-generation forces. The seismic activity sharply increases during certain cosmic conditions (many hundred percent). The cosmic conditions (of tide generating genesis) are outlined where the background of the seismic activity of

the Nevada territory sharply increases. The data concern both the intramonthly and the intradiurnal distribution of earthquakes.—Author's abstract

Tanguy, J. C. *See* Aitken, M. J. 03971

04008 **Tanner, William F.** Multiple influences on sea-level changes in the Tertiary, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 165–171, illus., 1968.

A plot of known exposures of coastal sediments, showing approximate age and present elevation in the southeastern states from Late Cretaceous and Tertiary time is evaluated. Five pre-Pleistocene points appear and make two line-segments on semilog paper. One, from Late Cretaceous to pre-Miocene, shows a drop of level of 50 m in 70×10^6 years. The second, from Miocene to Pliocene time, shows an additional drop of 75 m in 25×10^6 years. The first may be due to isostatic rebound from erosional unloading of the Appalachians, the second is from glacioeustatic changes. Structural events could inflict bias on the data, and it is impossible to distinguish epeirogenic and tectonic influences, although it is clear that the two line slopes have different origins. Two formulae are developed, one describing each line segment. They show isostatic rebound to be 500–600 m net and if no glacioeustatic changes had occurred, sea level would now be +68 feet.—HRC

04015 **Tanner, William F.** Tertiary sea level symposium—Introduction, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 7–14, illus., 1968.

Eleven papers making up the Tertiary sea level symposium (Spring 1967) are presented herewith. Their combined effect is to produce a "first approximation" Tertiary history of sea level involving a more-or-less steady drop, of 70–100 m, beginning about the middle of Miocene time. This history requires a careful reconsideration of identification of high marine terraces as having been formed in the Quaternary Period. The concept of possible glacio-eustatic oscillations, in the Tertiary, is explored in one paper. Data from Antarctica and the surrounding ocean show that a major influence on Miocene and later sea levels was the advent of extensive glaciation.—Author's summary

04169 **Tanner, William F.** Cause and development of an Ice Age [summ.], *in* Causes of climatic change—INQUA-NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 126–127, 1968.

Geologic evidence supports the postulate that continental glaciation is determined primarily by latitude. Paleomagnetic data show that North America was located close to a pole during each of its three extensive glaciations, the late Cenozoic and two Precambrian; at other times it was not. Onset of Pleistocene glaciation in North America may have been triggered by tectonism in the Bering Strait area which reduced the flow of warm water into the Arctic Ocean. A meteorological model, operating only on "wide" continents, is proposed to explain glacial-interglacial oscillation: an ice sheet in North America migrates southward; the rim grows higher as it migrates, until it starves its own starting area and finally melts when it reaches warm latitudes and dry altitudes. Isostatic rebound provides the time lag for long interglacial periods.—VMJ

04216 **Tarver, George R.** Ground-water resources of Polk County, Texas: Texas Water Devel. Board Rept. 82, 109 p., illus., tables, 1968.

Principal aquifers of Polk County—Catahoula Sandstone, and Jasper and Evangeline aquifers—contain fresh to slightly saline water to a depth of as much as 1,800 feet below sea level; in the southeastern part, the sand has a maximum thickness of about 800 feet. The southern two-thirds of the county can supply large quantities of fresh to slightly saline water of good chemical quality, but large supplies of fresh water are not available in the northern one-third. Ground-water resources are practically untapped; aquifers contain an estimated 55 million acre-feet in transient storage. Of this amount, about 10 million acre-feet is available to wells if aquifers are dewatered to 400 feet below land surface. About 34 mgd is the minimum rate at which water may be pumped indefinitely, and about 10

mgd more would be available by salvaging water presently rejected to streams as base flow.—*from* Author's abstract

04563 **Taylor, Frank.** Mitchell Caverns, California: Desert, v. 31, no. 11, p. 8–9, illus., 1968.

This article contains a brief, elementary discussion of how caves are formed. The history of Mitchell Caverns, north of Essex, California, is discussed.—KAF

Taylor, Richard B. *See* Kinney, Douglas M. 03994

Thaden, Robert E. *See* Gair, Jacob E. 04113

Thompson, Geoffrey. *See* Melson, W. G. 04367

Thompson, George A. *See* Meister, Laurent J. 04370

Thompson, Maxwell N. *See* Pannella, Giorgio. 04494

04394 **Thompson, Robert.** Geology in Wet Beaver Creek Canyon [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 25–26, 1968.

Thompson, Tommy B. *See* Giles, David L. 04154

Thorp, William H. *See* Browning, David G. 04468

04441 **Tilling, Robert I.; Klepper, Montis R.; Obradovich, John D.** K–Ar ages and time span of emplacement of the Boulder batholith, Montana: Am. Jour. Sci., v. 266, no. 8, p. 671–689, illus., table, 1968.

K–Ar ages of biotite and hornblende from the batholith and satellite masses range from 78 to 68 m.y. The emplacement could have taken as little as 5 m.y. (76–71 m.y.). Even though isotopic dates generally support field evidence for the intrusion sequence, reduction of K–Ar dates of older rocks in the vicinity of younger plutons is suspected. Making certain assumptions, the total emplacement time may have been about 9 m.y., and the bulk of the batholith was probably emplaced during the first 6 m.y. The youngest prebatholith rocks, the Elkhorn Mts. volcanics, are about 78 m.y. but may be slightly older. If so, the total emplacement time could even be as great as 10 to 12 m.y.—*from* Authors' abstract

Tilton, G. R. *See* Davis, G. L. 04522

Time-Life Books Editors. *See* Moore, Ruth. 04332

04155 **Titley, Spencer R.** Environment of deposition of the hydrothermal metamorphic (pyrometasomatic) deposits [abs.]: Econ. Geology, v. 63, no. 6, p. 699, 1968.

03984 **Townsend, P. D.** Measurement of charge trapping centers in geological specimens, Chap. 2.4 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 51–60, illus., 1968.

The most successful techniques for dating geological and archeological events have been the use of radioactive decay products and the measurement of thermoluminescence. Methods for measuring crystal defects, applicable to a study of sample age or thermal history, have more sources of error but may offer otherwise unobtainable information on thermal history or cosmic ray radiation. In thermoluminescence, data may be obtained comparable to that from radioactive decay, but quantitative measurements have stringent requirements. Guide lines for deciding whether particular defects may have geological applications are: those involving charge transfer effects are undesirable; total radiation dosage is best estimated from stable effects, and thermal history by using several defects of differing stability; care must be taken in accounting for change in the emission spectrum with temperature.—GDC

04328 **Traverse, A.; Ames, H. T.** (compilers). Catalog of fossil spores and pollen—V. 29, Mesozoic and Cenozoic spores, pollen and other microfossils: University Park, Pa., Pennsylvania State Univ. Palynol. Labs., 178 p., illus., 1968.

This volume presents 52 generic descriptions, protolog materials for 151 specific and infraspecific taxa, and two redescriptions of species, from seven papers published between 1955 and 1965; materials are from Germany in six of the papers, and are mostly of early and middle Mesozoic age. For the first time, species of several genera not strictly sporomorphs are described; this is in keeping with the policy announced in V. 27 [ibid., 1967], that in the future descriptions will be included for megaspores, bodies of probable algal relationship, and spore-size objects of uncertain but probable botanical relationship. In the only paper on U.S. material (Norem, 1955), *Tytthodiscus*, n.gen., a marine microfossil, and two new species of it are described from Eocene through Pliocene marine sediments of Wasco, Calif.—VMJ

04294 **Trendall, A. F.** Three great basins of Precambrian banded iron formation deposition—A systematic comparison: Geol. Soc. America Bull., v. 79, no. 11, p. 1527–1544, illus., table, 1968.

Three of the best preserved Precambrian iron formation basins, the Hamersley basin of Western Australia, the Animikie basin of the Lake Superior region of North America, and the Transvaal System basin of South Africa, are compared as a first step toward determining the source of the iron in such basins. These basin deposits differ from one another in the sequence, continuity, thickness, and variation in thickness of stratigraphic units in them. They are similar in age, size, chemistry, mineralogy, structural evolution, position of included chert, and presence of volcanic rocks, which in Australia seem to have been the source of the iron.—WHN

Trexler, J. Peter. *See* Wood, Gordon H., Jr. 04245

04019 **Troxel, Bennie W.** Possible relationship of faults in the Mojave Desert to the San Andreas fault [abs.], *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 281; discussion, p. 281–282, 1968.

04391 **Updike, Randall G.** Multiple Pleistocene glaciation of the San Francisco Peaks, Arizona [abs.]: Arizona Acad. Sci. Jour., v. 5, proc. supp., p. 24–25, 1968.

04178 **U.S. Army Corps of Engineers.** Water resources for central and southern Florida—App. [V.] 4, App. I, Geology and soils: Jacksonville, Fla., [U.S.] Dept. Army, Jacksonville District, Corps of Engineers, p. II–117, illus., 1968.

This appendix presents geologic, soils, and seepage information relative to the Everglades, Lake Okeechobee, and Hillsboro Lakes Marsh basins in the general area under consideration and relative to the plan of improvement. The majority of the data and figures presented is extracted from previous reports prepared for the Central and Southern Florida Flood Control Project. Additional geologic and soils data were obtained to complete the information necessary for certain planned improvements. Under physiography and drainage, tree islands and swales are considered, and under general geology overburden conditions, stratigraphy, structure, permeability of principal aquifer, materials encountered, and foundation conditions for canals and levees are discussed. A geologic sketch map, sections, and drilling logs are included among the 75 figures.—GDC

04180 **U.S. Bureau of Reclamation.** Earthquake activity in western United States—Dams Branch Report No. DD-8: Denver, Colo., U.S. Bur. Reclamation, 23 p., illus., tables, 1968.

In order that Bureau of Reclamation designers may have a ready reference covering the relative seismicity of the Western States, including Alaska and Hawaii, maps have been prepared showing epicentral locations and earthquake intensities. These earthquake data are given in historical accounts published by the Coast and Geodetic Survey. The maps are included in this report, as well as information on the various

scales which are used, or have been used, to establish earthquake size.—Author's abstract

U.S. Geological Survey. *See* Stanford Univ. School Earth Sci. 03956

04198 **U.S. Geological Survey.** Aeromagnetic map of central Pine County, Minnesota, and adjacent parts of Wisconsin: U.S. Geol. Survey Geophys. Inv. Map GP-636, scale 1:62,500, 1968.

04470 **U.S. Geological Survey.** Ground-water levels in the United States, 1961-65—Southwestern States: U.S. Geol. Survey Water-Supply Paper 1855, 125 p., illus., tables, 1968.

Beginning in 1956, only water-level data from a basic network of observation wells has been published by the U.S. Geological Survey. This basic network provides observation wells so located that the most significant data are obtained from the fewest wells in the most important aquifers. Publications that contain substantial additional water-level data are listed at the end of each State report (Arizona, California, Hawaii, Nevada, New Mexico) in this volume. Water-level measurements are given in feet with reference to either mean sea level or land-surface datum.—*from* Introduction

04364 **Vali, V.; Krogstad, R. S.; Moss, R. W.; Engel, René.** Some observations of strains across the Kern River fault using laser interferometer: Jour. Geophys. Research, v. 73, no. 18, p. 6143–6147, illus., 1968.

The use of a two-component laser interferometer to observe some short time effects across the Kern River fault is described. The instrument is located in a mine tunnel near Kernville, California. Typical events observed in August 1967 were caused by a small slippage along the fault some distance from the interferometer that caused a strain to appear at the instrument. Apparently these strains are relieved almost immediately, as some of the spikes are only two seconds long.—DBV

vanAndel, Tjeerd H. *See* Melson, W. G. 04367

VanVoast, W. A. *See* Cotter, R. D. 04378

03974 **Vaz, J. E.; Kemmey, P. J.; Levy, P. W.** The effects of ultraviolet light illumination on the thermoluminescence of calcite, Chap. 3.3 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 111–123, illus., 1968.

Analyses of light emitted from heated calcium carbonates have been used in a variety of geological studies, such as stratigraphic correlation, age determinations, geothermometry, and paleoclimatology. Calcite subjected to ionizing radiation usually has four glow peaks above room temperature. These occurred at 100°, 220°, 320°, and 350°C at the heating rate used in this experimental ultraviolet illumination of calcite from Joplin, Mo., to determine bleaching effects on glow peak intensities. The greatest variations between specimens occur in the region of the first peak; the next two peaks, common to most specimens, have been used in paleoclimate and dating studies; the last peak is affected by mechanical treatment of the material. The glow peaks have been attributed to thermal release of charges from traps; this investigation of charge redistribution kinetics supports the possibility of considerable retrapping.—GDC

Vaz, J. Eduardo. *See* Siegel, Frederic R. 03954

04414 **Vedder, J. G.** Geologic map of Fox Mountain quadrangle, Santa Barbara County, California: U.S. Geol. Survey Misc. Geol. Inv. Map I-547, scale 1:24,000, sections, 1968.

04056 **Vedder, John G.; Brown, Robert D., Jr.** Structural and stratigraphic relations along the Nacimiento fault in the southern Santa Lucia Range and San Rafael Mountains, California, *in* Conference on geologic problems of San Andreas fault

system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 242–258, illus., table; discussion, p. 258–259, 1968.

The Nacimiento fault may mark the southwest boundary of the Salinian granitic block. Mapping was done along an extension of the fault southeast of Salinas reservoir, terminating against Big Pine fault. Juxtaposed geologic units of regional extent and detailed structural and stratigraphic relations along the fault demonstrate large vertical movements from post–Late Cretaceous to Miocene time; rocks to the northeast are downfaulted. Where the fault cuts the Miocene, a movement down to the southwest is indicated. Strike-slip cannot be eliminated as a possibility but is judged unlikely. Early Tertiary and older faunal data are tabulated. The fault ceased moving as a master tectonic feature prior to deposition of Miocene marine rocks; the fault plane may be folded. Big Pine fault seems to have offset the Nacimiento 10 mi east where the extension is known as the Pine Mtn. fault.—ESL

04511 **Vigrass, Laurence W.** Geology of Canadian heavy oil sands, *in* Rocky Mountains–Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1984–1999, illus., 1968.

About 750 billion bbl of viscous heavy oil is in place in the southern interior plains of western Canada; most is in sandstone beds of the Lower Cretaceous Mannville Group along a 600-mi belt that extends from Peace River, Alberta, through the 'Athabasca tar sands' area to Lloydminster, Saskatchewan. The accumulation at Peace River (50 billion bbl) is in a regional updip sandstone pinchout. Accumulations in the Athabasca–Lloydminster region (700 billion bbl) lie across the crest or on the southwest flank of a regional anticlinal feature associated with the solution of salt from Middle Devonian beds. The most acceptable hypothesis of origin is that hydrocarbons which moved out of the deep basin in micellar or colloidal solution in compaction waters were 'precipitated' on anticlinal structures or in sandstone pinchouts, possibly as a result of a change of salinity of the formation water.—*from* Author's abstract

04403 **Vilks, G.** Foraminiferal study of the Magdalen Shallows, Gulf of St. Lawrence: Maritime Sediments, v. 4, no. 1, p. 14–21, illus., table, 1968.

Bottom conditions on the Magdalen Shallows are characterized by low water temperatures, coarse sediments, and relatively featureless submarine topography; shallower nearshore waters, with drastic seasonal changes in temperature, are also exposed to lower salinities than the central part. The bottom sediment is chiefly reddish-brown sand with some pebbles and cobbles of red sandstone; it is less well sorted near Prince Edward Island than in the vicinity of the Magdalen Islands. The small foraminiferal population is dominated by arenaceous species, the more abundant of which are dealt with in detail, comparing their distribution here with that in the Arctic and North Atlantic Oceans. In the Magdalen Shallows, more species per sample are at deeper offshore stations; finer sediments contain more fauna, except *Eggerella advena* which appears to be more abundant in coarser sediments; the fauna is comparable to Arctic forms.—GDC

04133 **Villaseñor, Luis.** Application of geology in development and exploitation of the Naica and Fresnillo mines, Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 701–702, 1968.

04128 **vonHake, Carl A.; Cloud, William K.** United States earthquakes, 1966: Washington, D.C., U.S. Coast and Geod. Survey, 110 p., illus., tables, 1968.

Earthquake reports collected by the National Earthquake Information Center of the Coast and Geodetic Survey are summarized for the continental United States, Alaska, Hawaii, Panama Canal Zone, Puerto Rico, and the Virgin Islands. Additional information includes geodetic work of seismological interest, tidal disturbances of seismic origin, fluctuations in well-water levels, seismological observatories, principal earthquakes of the world during 1966, and strong-motion seismograph results.—MCM

04336 **vonHake, Carl A.; Cloud, William K.** United States earthquakes, 1965: Washington, D.C., U.S. Coast and Geod. Survey, 91 p., illus., tables, 1968.

This is a summary of earthquake activity in the United States during 1965 from instrumental sources, noninstrumental information supplied by observers who prepare periodic reports of local seismic activity, and other local sources such as newspaper clippings. Fluctuations in well-water levels are tabulated, and miscellaneous activities of the Coast and Geodetic Survey related to seismic activity are reported.—MST

VonRad, Ulrich. *See* Rees, Anthony I. 04425

04284 **Walker, J. W.; Pearce, D. C.; Zanella, A. H.** Airborne radar sounding of the Greenland ice cap—Flight 1: Geol. Soc. America Bull., v. 79, no. 11, p. 1639-1646, illus., 1968.

The dielectric properties of cold, dry ice in the polar icecaps are favorable for the use of a radar technique in rapid and continuous measurement of ice thickness from an aircraft. The instrumentation and method are described with reference to a 1,000-mile profile in north-central Greenland. Maximum ice thickness recorded was 3300±50 m and bedrock surface elevations are generally close to sea level.—AG

03952 **Wallace, Robert E.** Notes on stream channels offset by the San Andreas fault, southern Coast Ranges, California, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 6-20, illus.; discussion, p. 20-21, 1968.

More than 130 stream channels have been displaced by right-lateral slip on the San Andreas along Highway 33 between Cholame and Camp Dix; of these, 40 are offset between 20 and 50 feet. Configuration of an offset stream channel is the result of interaction of the erosion-sedimentation process and tectonic movement. Recurrent slip along a narrow fault strand is indicated by the presence of more than one downstream segment related to a single upstream channel. Such evidence suggests that the most recently active strand is likely to have recurrent movement and to be active in the future. Amount of displacement varies along a single fault strand, and many strands are only a few miles long. The individual strands are arranged en echelon and in other interrupted or interlacing patterns. Accurate displacement rates have not yet been determined.—*from* Author's abstract

Wallace, Robert E. *See* Brown, Robert D., Jr. 03953

04480 **Ward, P. L.; Matumoto, T.** A summary of volcanic and seismic activity in Katmai National Monument, Alaska: Bull. Volcanol., v. 31, p. 107-129, illus., tables, 1968.

A compilation of observations of volcanic eruptions since 1870 and ash stratigraphy shows that Katmai National Monument on the Alaska Peninsula has had a long history of volcanic activity. Six of the recently active vents lie in a gently curved arc, but two lie to the north of this arc and show no obvious structural relationship to it. Recent volcanic events have consisted of fumarolic activity, steaming from main vents, ash eruptions, extrusion of viscous lava flows, and pyroclastic eruptions. The observed activity shows no obvious correlation with a compilation of seismic events recorded teleseismically since 1912 and relocated by the authors using a digital computer. The eruption attributed to Mt. Katmai in 1912 has left many unanswered questions including the thickness of the ash flow tuff in the Valley of Ten Thousand Smokes.—*from* Authors' abstract

04489 **Warner, M. A.; Shelburne, O. B.; Bitter, Reed K.; Rea, Bayard D.** (editors). Rocky Mountains—Breaking barrier boundaries: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 10, p. 1848-2057, illus., tables, 1968.

"Breaking barrier boundaries" was the theme of the 17th Annual Meeting of the Rocky Mountain Section of the American Association of Petroleum Geologists at Casper, Wyoming in October 1967. Seven of the papers in this volume were selected from those presented at Casper. Four other papers have been added because of current interest in the areas and because they provide companion pieces to the papers already selected. The 11 papers are cited separately.—VSN

04235 **Warren, C. Gerald.** The synthesis of ferroselite from an aqueous solution at low temperature: Econ. Geology, v. 63, no. 4, p. 418–419, 1968.

The synthesis was attempted because natural occurrences in sandstone-type uranium deposits clearly formed at temperatures much lower than those of previous syntheses, and in an aqueous environment. The synthesis involved placing FeS in a solution of sodium selenosulfate for ten days at 80°C under an oxygen-free atmosphere.—WSW

04092 **Watanabe, R. Y.** Petrology of cataclastic rocks of northeastern Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 209, 1968.

04415 **Waters, A. C.** Reconnaissance geologic map of the Dufur quadrangle, Hood River, Sherman, and Wasco Counties, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-556, scale 1:125,000, 1968.

Weimer, R. J. *See* Hoyt, J. H. 03977

Weimer, Robert J. *See* Hollister, John C. 04310

04093 **Weiner, J. L.** The Old Fort Point Formation, Jasper, Alberta [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 210, 1968.

04203 **Weis, P. L.** Geologic map of the Greenacres quadrangle, Washington and Idaho: U.S. Geol. Survey Geol. Quad. Map GQ-734, scale 1:62,500, sections, 1968.

Welday, E. E. *See* Woodford, A. O. 04291

Welp, Theodore L. *See* Lemish, John. 04142

04036 **Wentworth, Carl M.** Upper Cretaceous and lower Tertiary strata near Gualala, California, and inferred large right slip on the San Andreas fault, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 130–143, illus., 1968.

A minimum post-Cretaceous right slip of 270 mi is suggested by restrictions on the location of the source of plagioclase arkose and associated conglomerate of the strata of Anchor Bay. Lithologic dissimilarity of the strata of Stewarts Point and Anchor Bay near Gualala and strata of similar age in the southeastern Diablo Range, and probably any in the Temblor Range, supports this amount of minimum right slip and may extend it to 320 mi. The basement of the Gualala block may be Franciscan, in which case maximum displacement along the San Andreas fault would approximate 350 mi. Juxtaposition of different source terranes across the Gualala basin and the shape and history of the basin itself suggest existence of the San Andreas fault in Late Cretaceous time. Paleocurrent information is quite sparse, and petrology of conglomerate clasts warrants further study.—*from* Author's conclusions

04448 **Westfall, Dwayne Gene.** Effect of drying on aluminum and other extractable cations in some strongly acid soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 2, p. 446B–447B, 1968.

Wetherill, G. W. *See* Gopalan, K. 04184

04162 **Weyl, Peter K.** The role of the oceans in climatic change—A theory of the Ice Ages, *in* Causes of climatic change—INQUA-NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 37–62, illus., tables, 1968.

Changes in the surface salinity distribution in the World Ocean, by changing the extent of sea ice in the North Atlantic and Antarctic, can lead to climatic change. By reducing the water vapor flux across Central America, the salinity of the North Atlantic is reduced. If this change persists over a sufficient length of time, a glacial climate could be initiated. An examination of the "Little Ice Age" tends to confirm this hypothesis. A return to an interglacial climate may be the result of overextension

of glaciers followed by stagnation of the bottom water. Stagnation is terminated by geothermal heating at the ocean floor, followed by vertical mixing of the warmed, saltier water into the subarctic gyre of the North Atlantic. This, in turn, results in a reduction of sea ice and in climatic warming.—Author's abstract

04482 **Weyl, R.** Volcanoes and volcanic rocks in Central America and the West Indies: Bull. Volcanol., v. 31, p. 3–12, illus., 1968.

The purpose of this paper is to point out the similarity of the magmatic products in the circum-Caribbean region, and to show the geologic objections to the hypothesis of the production of sialic magmas by melting of the root of a sialic crust. These objections were presented only from the viewpoint of a geologist. They may show the necessity of other hypotheses as have been developed by Ewing, Gorshkov, Hess, Donnelly, Wilson and others.—Author's abstract

04481 **Wheeler, H. E.; Coombs, H. A.** Late Cenozoic mesa basalt sheet in northwestern United States: Bull. Volcanol., v. 31, p. 21–43, illus., table, 1968.

Numerous occurrences of late Cenozoic (late Pliocene or early Quaternary) diktytaxitic, olivine basalt in Oregon, northeastern California, northwestern Nevada and southwestern Idaho are interpreted as remnants of a regionally extensive, thin basalt sheet, manifesting a single volcanic event of vast magnitude.—Authors' abstract

04224 **White, Donald E.** Environments of generation of some base-metal ore deposits: Econ. Geology, v. 63, no. 4, p. 301–335, illus., tables, 1968.

The origin of the ore fluids, their dissolved constituents, the force that drives them, and the causes for deposition of their constituents are reviewed for five districts: Providencia, Mexico; Mississippi Valley (Pb–Zn); Salton Sea geothermal system; Red Sea geothermal system; Nonesuch Shale, Michigan. The compositions (chemical and isotopic) and temperatures, determined directly for brines and from fluid inclusions for ancient deposits, reveal significant differences between the Providencia deposit (close magmatic affiliations) and the others, in which connate water and constituents dissolved from country rock appear to be important. Deposits formed by complex processes, with multiple sources for materials, may well be more common than simple "end-member" deposits.—WSW

04301 **White, H. Gene.** The petroleum industry in Alabama, 1965–1966: Alabama Geol. Survey Circ. 48, 41 p., illus., tables, 1968.

The report consists of 16 tables and a map showing oil and gas fields, refineries, and pipelines; a graph shows annual oil production from 1944–66. Two tables give a summary of the oil-producing industry for 1965–66 and gas production in the Whitehouse field for the same years, four show records of productive wells and dry and abandoned wells completed in 1965 and 1966, and the remaining ten give oil production from individual wells in five fields for the same years.—ESL

04335 **White, John A.** A new porcupine from the Middle Pleistocene of the Anza-Borrego Desert of California—With notes on mastication in *Coendou* and *Erethizon*: Los Angeles County Mus. Contr. Sci., no. 136, 15 p., illus., tables, 1968.

A new species of *Coendou* is described from the Middle Pleistocene [Palm Springs Formation] of the Anza-Borrego Desert. The genera *Coendou* and *Erethizon* are distinguished from one another by means of inferred differences in mastication, and it is postulated that *Coendou* is ancestral to *Erethizon*.—Author's abstract

03995 **Whitebread, Donald H.; Hoover, Donald B.** Preliminary results of geological, geochemical, and geophysical studies in part of the Virginia City quadrangle, Nevada: U.S. Geol. Survey Circ. 596, 20 p., illus., 1968.

Geological, geochemical, and geophysical studies in the Comstock Lode district and adjoining parts of the Virginia Range near Virginia City, Nev., have resulted in recognition of two geophysical anomalies and several geochemical anomalies in an area north of Virginia City. The geophysical anomalies were found during an

induced-polarization survey carried out to aid in tracing the Comstock fault, the principal structure localizing the bonanza silver-gold deposits of the Comstock Lode district, in an area of intensely altered rock and alluvial cover about five miles north of Virginia City. Geochemical anomalies showing mercury in excess of 5 ppm were found in altered rocks along the Comstock fault near Cornwall Knob about five miles north of Virginia City and in the Washington Hill area, six miles farther north.—Authors' abstract

04263 **Whiting, Robert L.** Geothermal energy and resources: Oil and Gas Compact Bull., v. 27, no. 1, p. 15–21, illus., table, 1968.

Steam or hot water under elevated pressure and temperature is usually located by drilling wells in the conventional manner. Principal reservoirs are in areas of Cenozoic volcanism, have an impervious cap, and are located either in an orogenic belt affected by late Pliocene or Quaternary uplift, or in deep structural depressions associated with large late Tertiary and Quaternary displacements. The most productive wells are those drilled into faults. Areas of volcanic or seismic activity have received the most attention, especially where there are hot springs, geysers, and fumaroles. Only six countries are harnessing this energy at present; most successful installations are at Larderello, Italy, and Wairakei, New Zealand. In the United States, the area west of the east slope of the Rocky Mountains is a potential area for prospecting and the Big Geysers area, Calif., the most successful producer.—ESL

04499 **Wiebe, Robert A.** Plagioclase stratigraphy—A record of magmatic conditions and events in a granite stock: Am. Jour. Sci., v. 266, no. 8, p. 690–703, illus., 1968.

Details of plagioclase zoning were correlated throughout a 3-sq mi quartz monzonite stock on Mount Pilchuk, Wash. A typical zone sequence in all phenocrysts is: andesine cores with oscillatory zoning; core-rim boundaries marked by sharp drops of 8 to 15 percent An, and rims normally zoned from An_{28} to An_{15}. Discontinuities between rims and cores represent a period of core resorption and non-crystallization caused by pressure decrease during intrusion. Coarse oscillations within cores (3 to 7 percent An) record convection and turbulence in an inhomogeneous magma during the early stages of crystallization. Constant composition of the outermost core zones indicates homogenization of the magma prior to and during intrusion. Zones within the outermost core show low compositional correlation and indicate a high degree of crystal mixing.—*from* Author's abstract

Wilding, L. P. *See* Smeck, Neil E. 04193

04352 **Williams, H.** Geology, Wesleyville, Newfoundland: Canada Geol. Survey Map 1227A, scale 1:253,440, text, 1968.

Granite is the most abundant rock type in the Wesleyville area, with lesser amounts of medium- to high-grade metamorphic rocks. Tightly folded but relatively unmetamorphosed sedimentary rocks occur locally in the southwestern corner. The geotectonic setting of the area is the eastern margin of the once-mobile central Paleozoic belt of northeastern Newfoundland. Based on field relations and isotopic dates in adjoining map-areas, all igneous rocks are generally considered to be of Devonian age. Few mineral prospects are known.—MCM

04089 **Williams, H. H.** Some aspects of ion exchange in shales [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 207, 1968.

Williams, William P. *See* Fernald, Arthur T. 04177

Willis, James N. *See* Duke, Thomas W. 04496

Wil[illegible] **Donald L.** *See* Ray, Clayton E. 04379

04305 **Wilshire, H. G.; Howard, Keith A.** Structural pattern in central uplifts of cryptoexplosion structures as typified by Sierra Madera: Science, v. 162, no. 3850, p. 258–261, illus., 1968.

The pattern of deformation in central uplifts of Sierra Madera and other well-known cryptoexplosion structures indicates that inward as well as upward movement of strata formed the uplifts. This kind of movement is incompatible with structures not of impact origin with which they have been compared. The structural style of cryptoexplosion structures, together with features that suggest shock deformation, supports the belief that they are the eroded roots of impact craters.—Authors' abstract

04148 **Wilson, Ivan F.** Metallogenetic provinces of Mexico [abs.]: Econ. Geology, v. 63, no. 6, p. 700, 1968.

04007 **Wilson, John A.** Tertiary shorelines, Texas Coastal Plain, *in* Tertiary sea-level fluctuations (W. F. Tanner, editor): Palaeogeography, Palaeoclimatology, Palaeoecology, v. 5, no. 1, p. 135–140, 1968.

The present shoreline in Texas is one reference line and the area of outcrop of each series is another. At outcrop, Paleocene Midway deposits are marine; Eocene are alternately marine and continental; Oligocene, Miocene, and Pliocene surface rocks are continental with an exception of brackish-water deposits in mid-Miocene of eastern Texas. The Paleocene shoreline was to the north of the Midway Group outcrop area; it fluctuated in the Eocene; and the shoreline was to the south during the Oligocene–Pliocene interval, although it fluctuated north and south of the present shoreline. A post-early Pliocene—pre-middle Pleistocene unconformity underlies widespread high-level sands, gravels, and caliche, which were deposited prior to the present day stream incisions.—*from* Author's summary

04374 **Wilson, M. E.** Dokembriy Kanady (Kanadskiy Shchit), *in* Dokembriy Kanady, Grenlandii, Britanskikh Ostrovov, i Shpitsbergena (K. Rankama, editor): Moscow, Izdatel'stvo "MIR" 336–269, illus., tables, 1968; originally published in English, 1965.

This is a Russian translation of the article by M. E. Wilson *in* The geologic systems—The Precambrian, V. 2 (Kalervo Rankama, editor): New York, London, Interscience Publishers, 1965. *See* Abstracts of North American Geology for October 1966.—VSN

04102 **Wilson, William F.; Allen, Eldon P.** Spilitic amygdaloidal basalt flow rocks and associated pillow structure in Orange County, North Carolina: Southeastern Geology, v. 9, no. 3, p. 133–141, illus., table, 1968.

Pillowed spilitic amygdaloidal basalt flow rocks have been recognized at five locations in the metavolcanic pyroclastic rocks and volcaniclastic epiclastic rocks of Orange County, North Carolina. These pillowed lavas are the first such flow rocks to be recognized, identified, and described in the metavolcanics of the Carolina Slate Belt in North Carolina. The presence of pillow structure and the spilitic composition strongly suggest that the metavolcanic rocks of the area are of eugeosynclinal deposition. The basalt flow rocks follow the regional northeast trend of the metavolcanic rocks in the area and dip vertically or steeply northwest, and in places are interbedded and overlain by basaltic tuffs that exhibit excellent graded bedding. This data further indicates that, in places, the basalt flow rocks and interbedded tuffs are of subaqueous deposition.—*from* Authors' abstract

04090 **Wind, G.** Structural geology of the northern Dogtooth Range, British Columbia [abs.]: Bull. Canadian Petroleum Geology, v. 16, no. 2, p. 207–208, 1968.

04464 **Wingerter, H. R.** Greenwood gas field, Kansas, Colorado, and Oklahoma, *in* Natural gases of North America—Pt. 3, Natural gases in rocks of Paleozoic age: Am. Assoc. Petroleum Geologists Mem. 9, v. 2, p. 1557–1566, illus., table, 1968.

The Greenwood gas field of Morton County, Kansas, Baca County, Colorado, and Texas County, Oklahoma, is on the west flank of the Hugoton embayment of the

Anadarko basin where porous Upper Pennsylvanian (Virgil) limestone beds grade westward to impermeable limestone and clastic rocks, creating a major stratigraphic trap for gas. The Greenwood gas field is on a monoclinal feature north of the Cimarron uplift. The shallow-water environment of deposition resulted in optimum conditions for the development of porosity and permeability in the limestone reservoir beds. As of the end of 1963, 275 gas wells had been drilled, proving an area of about 214,000 acres with recoverable gas reserves of about 1 trillion cu ft.—*from* Author's abstract

Winter, T. C. *See* Maclay, R. W. 04424

Wolfe, Douglas A. *See* Duke, Thomas W. 04496

04245 **Wood, Gordon H., Jr.; Trexler, J. Peter; Kehn, Thomas M.** Geologic maps of anthracite-bearing rocks in the west-central part of the southern anthracite field, Pennsylvania, eastern area: U.S. Geol. Survey Misc. Geol. Inv. Map I-529, 6 sheets, scale 1:12,000, sections, 1968.

The four map sheets cover the Minersville quadrangle, the southern half and part of the northern half of the Tremont quadrangle, part of the northern half of the Swatara Hill quadrangle, and the northern half and part of the southern half of the Pine Grove quadrangle; two sheets of structure sections cover the same four areas.—MCM

04291 **Woodford, A. O.; Welday, E. E.; Merriam, Richard.** Siliceous tuff clasts in the upper Paleogene of southern California: Geol. Soc. America Bull., v. 79, no. 11, p. 1461-1486, illus., tables, 1968.

Pebbles, cobbles, and boulders of rhyolitic and other siliceous tuffs are abundant in conglomerates that crop out between Los Angeles and San Diego. Typical clasts are made up of feldspar and quartz crystals in a fine-grained groundmass. Possible source rocks of similar lithology and appropriate age include the Sidewinder Volcanics of the Mojave Desert, northeast of Los Angeles and 70 to 140 miles north of the conglomerate outcrops, and the Imuris Volcanics of northern Sonora, 400 miles southeast of San Diego. Possibly the conglomerate clasts were derived from much nearer, but now unavailable sources, either higher levels of the Peninsular Ranges of southern California (above the present erosion surface) or rocks down-faulted beneath the Salton Trough east of these ranges.—*from* Authors' abstract

04271 **Woodriff, Ray; Stone, Ronald W.; Held, Andrew M.** Electrothermal atomization for atomic absorption analysis: Appl. Spectroscopy, v. 22, no. 5, p. 408-411, illus., tables, 1968.

In recent years atomic absorption in flames has been extensively applied to analysis of both industrial and geologic materials. Now the application of electrically heated tubes for evaporation and atomization of samples promises to provide the basis for even greater sensitivity and accuracy. In the furnace, we have an inert, nonturbulent, slow moving atmosphere with a controllable uniform temperature. The gas stream in the furnace is at a lower temperature than the walls. This tends to force suspended particles to the center where they evaporate and pass on into the light beam. It also tends to minimize or eliminate memory effects and matrix effects. The operation of the furnace is described and results are given for analysis of samples containing diverse matrix elements.—*from* Authors' abstract

04163 **Worthington, L. V.** Genesis and evolution of water masses, *in* Causes of climatic change—INQUA-NCAR Symposium, Boulder, Colo., 1965 (INQUA, 7th Cong., 1965, Proc., V. 5): Meteorol. Mons., v. 8, no. 30, p. 63-67, illus., 1968.

The main water masses of the oceans are described as they exist at the present time. It is postulated that at the height of the Wisconsin glacial period the mean salinity of the oceans was 35.7 percent, one part per thousand more saline than it is now. The evolution and eventual dissipation of the Wisconsin bottom water mass is discussed together with the possible effect of this water mass on pelagic sediments.—Author's abstract

04465 **Worzel, J. Lamar; Leyden, Robert; Ewing, Maurice.** Newly discovered diapirs in Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 52, no. 7, p. 1194–1203, illus., 1968.

New geophysical data are presented from recent surveys in the Sigsbee Deep and Bay of Campeche. Reflection-profiler records are shown which indicate the existence of a zone of structures of diapiric appearance extending continuously from the Sigsbee Deep to within 75 mi of the Tabasco–Campeche Saline basin. The locations of 36 buried features termed "domes" and of 124 emergent features termed in agreement with previous findings, rule out an igneous origin for diapiric features. The combined geophysical evidence and proximity to known salt domes in Mexico support the hypothesis that the diapiric features are of salt origin.—Authors' abstract

04559 **Worzel, J. Lamar.** Survey of continental margins, *in* Geology of shelf seas—Inter-University Geol. Cong., 14th, Proc.: Edinburgh and London, Oliver and Boyd, p. 117–152, illus., 1968.

Conclusions from a summary of data of seismic reflection and refraction and gravity surveys along continental margins are: The sedimentary cover of continental shelves varies from 0 to 5 km; sedimentary and deeper layers outcrop on continental shelves, in some places, and are draped over deeper beds in others; there is a larger quantity of sediments beneath the continental rise than beneath shelves; the continental rise is formed by terrigenous sediments transported by turbidity and nepheloid currents; the continent edge is approximately beneath the 2,000 m isobath; oceanic crustal layers give way to continental layers in a distance of 100 to 200 km, commencing about 50–100 km seaward of the continental edge; continental margins deviate only slightly from isostatic equilibrium; and maximum isostatic adjustments at the continental margin have occurred beneath the seaward edge of the continental slope.—*from* Author's abstract

Wright, Herbert E., Jr. *See* Morrison, Roger B. 03988

04290 **Wright, J. B.** Polarity reversals and oxidation state in rocks: Royal Astron. Soc. Geophys. Jour., v. 16, no. 2, p. 161–167, illus., 1968.

The correlation between reversed polarity in rocks and strong oxidation of magnetic minerals is briefly re-examined, with special reference to a well-documented Columbia Plateau basalt suite. The correlation appears to vary in quality from place to place and some reasons for this are suggested. The only known petrographic criterion which can distinguish reversely from normally magnetized rocks is their higher oxidation states. This implies that the water content of magmas, and perhaps of high-grade metamorphic rocks, is somehow increased during episodes of reversed polarity, so that a slightly larger proportion of rocks is more strongly oxidized. Since motions of the Earth's core, upper mantle processes, and field reversals are apparently all related, compositional changes originating in the upper mantle could well be also related to field reversals.—*from* Author's abstract

Wright, T. L. *See* Desborough, George A. 04124

Wyttenbach, A. *See* Balsiger, H. 04524

04025 **Yeats, Robert S.** Rifting and rafting in the southern California borderland, *in* Conference on geologic problems of San Andreas fault system, Stanford, Calif., 1967, Proc.: Stanford Univ. Pubs. Geol. Sci., v. 11, p. 307–320, illus.: discussion, p. 320–322, 1968.

A working hypothesis for the tectonic evolution of southern California consists of three parts: (1) overthrusting in the late Mesozoic, (2) coastal plain sedimentation without accompanying sharp folding and faulting from Late Cretaceous to early Miocene, and (3) Miocene rafting of granitic blocks and their sedimentary veneer over an autochthon composed of Franciscan Formation, Catalina Schist, and Pelona Schist, which are assumed to be correlative. It is hoped that presentation of the hypothesis together with its supporting evidence will be of assistance in detailed geological and geophysical studies now underway in the Coast Ranges and the San Andreas fault zone.—*from* Author's summary

04247 **Young, Eleanor.** Urban planning for sand and gravel needs: California Div. Mines and Geology Mineral Inf. Service, v. 21, no. 10, p. 147–150, illus., 1968.

Planning for the optimum use of sand and gravel resources and the most suitable use of the land after excavation should begin with an engineering geologic study of the entire planning jurisdiction. Mapping of sand and gravel deposits enables city planners to designate these locales as a mineral preserve zone, and operations can be regulated by conditional use permits. Deposits located near urbanizing parts of the jurisdiction should be considered first. Sand and gravel operations throughout California have been conducted within a wide range of regulations. Suggested standards are: construction of berms, preservation of top soil and natural vegetation, control of drainage, a rehabilitation plan, and bond for faithful performance. Sketches show suggested uses of the used-up pit.—ESL

Yund, R. A. *See* Giletti, B. J. 04137

Zablocki, Charles J. *See* Gott, Garland B. 03996

Zanella, A. H. *See* Walker, J. W. 04284

04111 **Zartman, R. E.** Isotopic composition of lead, *in* Reconnaissance geology, geophysics, and geochemistry of the southeastern part of the Lewis and Clark Range, Montana: U.S. Geol. Survey Bull. 1252-E, p. E31–E32, table, 1968.

Isotopic composition of lead in galena from Cambrian and Devonian rocks is different from that found in Precambrian rocks, and that of Cambrian and Devonian leads (enriched in radiogenic isotopes) is not similar to other leads recorded in Montana. Lead in the Precambrian Spokane Formation and Helena Dolomite is similar in composition to leads in deposits in Precambrian rocks in the Sullivan mine, British Columbia, in the Coeur d'Alene district, Idaho, and in the Flathead Lake area, Mont. Model ages of leads from the four units are inconsistent between samples and not compatible with other geologic data; they range from Precambrian into the future, and yet all deposits are believed to have formed after Laramide thrust faulting.—MCM

04011 **Zeller, Anke N.** Preliminary investigation of the effect of deglaciation upon the thermoluminescence of rock, Chap. 9.3 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 519–523, illus., table, 1968.

Rock exposed to solar radiation loses thermoluminescence; shallow burial by water or ice will cause a shift to colder environment and increased thermoluminescence. Such changes may be compared to microclimatic variations. Experiments on Mesozoic limestones from a recently deglaciated valley in Switzerland were complicated by the problem of irregular exposure in multiple glacier retreats and advances. In general, their heating indices reflect increasing time for solar radiation with increasing distance from the glacier. In areas of Pleistocene continental glaciation, polar regions might be most favorable for future tests, especially Antarctic valleys. Previous radiation counting techniques are avoided by using the high glow peak as a natural dosimeter. Potential applications of this method include determining rate of emergence of shorelines, and solar bleaching of structural blocks in archeology.—GDC

04013 **Zeller, Anke N.** The influence of microclimate upon the thermoluminescence of rock, Chap. 9.2 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 507–518, illus., tables, 1968.

Natural thermoluminescence of rock from outcrop surfaces is extremely sensitive to microclimatic variations in temperature. The degree to which rock is heated depends on amount of solar radiation relative to variation in slope, roughness, infrared absorptivity and moisture content of rock, transfer in depth, and loss by evaporation, also on air movement and vegetative cover. In sampling for thermoluminescence studies, avoid outcrops having inhomogeneous heat transfer, heating by excessive drilling, and surfaces recently exposed to solar radiation.

Response time is shortened and erosion less critical in hot climates than in cold. Short-term temperature fluctuations are not thought to be detectable with this method, but the integrating nature of the phenomenon would allow determination of average temperatures. At present only comparative studies are possible. Archeological materials of which the climatic history is known may be useful to evaluate these low rate processes.—GDC

03969 **Zeller, Edward J.** Use of electron spin resonance for measurement of natural radiation damage, Chap. 5.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 271–279, illus., 1968.

Electron spin resonance, a highly sensitive detector of radiation effects in common minerals, has substantial advantages over thermoluminescence in that it measures static rather than dynamic conditions in crystals; and ESR characteristics of crystals are essentially independent of their optical properties. The ability to detect charges in very deep traps is probably the greatest advantage of the ESR method for geological uses. Of thirty minerals tested, three with signals which could be modified by radiation treatment showed definite promise: zircon for geothermometry and climatic studies; apatite for age determination; calcite provides a link between ESR and the extensive work in thermoluminescence. In tests made on samples of Permian limestone and dolomite, signals were often modified by geologic history and lithologic properties.—GDC

03970 **Zeller, Edward J.** Geologic age determination by thermoluminescence, Chap. 6.1 *in* Thermoluminescence of geological materials—NATO Advanced Research Inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 311–325, illus., 1968.

Two older methods of thermoluminescence age determination—natural and artificial—have been modified and combined into a new technique for solving practical geological problems. Because of large annealing effects in experiments, ultraviolet bleaching of natural thermoluminescence rather than thermal deactivation is recommended. Shape of saturation curve and value attained at saturation depend on nature of the irradiation and its flux rate, but this fact does not prevent use of these parameters for relative age determinations. If careful attention is paid to post-irradiation effects, consistent data can be obtained. Errors resulting from grinding and instrumentation have been reduced; a new fission track may eliminate the problem of counting techniques used to determine radioactivity of samples. Interpretation of experimental results will be more accurate with careful attention to geology of the collecting site.—GDC

04262 **Zietz, Isidore.** Proposed aeromagnetic map of the United States: Geotimes, v. 13, no. 8, p. 22–25, illus., 1968.

An experimental magnetic survey was flown covering a strip 100 mi wide across the United States and its continental shelves, crossing most of the major tectonic elements. In the west, a northwesterly magnetic grain is found; east of the Sierra, data show an east-trending grain as far east as Nebraska; in the east, the grain is northeasterly. The Basin and Range province appears to be underlain by silicic material to depth, and the Curie point is shallow. Linear east-west gradients in the west may be related to fracture zones. The success of this survey demonstrates the desirability of similar coverage for the whole country. An index map showing magnetic coverage to date includes airborne, shipborne, and ground measurements.—ESL

Zimmerman, D. W. *See* Cameron, John R. 03961

03962 **Zimmerman, D. W.; Cameron, J. R.** Supralinearity of thermoluminescence of LiF versus dose, Chap. 8.5 *in* Thermoluminescence of geological materials—NATO Advanced Research inst., Spoleto, Italy, 1966, Proc.: London and New York, Academic Press, p. 485–491, illus., 1968.

As supralinearity also occurs in some minerals, lithium fluoride is of some experimental interest. Supralinearity noted in this paper occurs at the intermediate

range where slope of the glow-curve increases before leveling off. Varying with quality of the energy beam, amount of supralinearity appears to be inversely related to ion density. The basic TL mechanism in LiF is only partially understood. Possible explanations discussed are: optical density of bands resulting from creation by the irradiation of electron traps believed to be associated with absorption bands in the 230–280 nm region; TL spectra depending on recombination centers, old and new, showing no change; the 1-percent efficiency of energy transfer between traps and recombination centers for production of TL photons could improve.—GDC

04423 **Zulberti, J. L.** Bouquet Canyon oil field: California Div. Oil and Gas, California Oil Fields—Summ. Operations 1967, v. 53, no. 2, pt. 2, p. 57–61, illus., tables, 1968.

Bouquet Canyon, a minor oil field of west-central Los Angeles County, lies just north of the San Gabriel fault; the fault, however, is not one of the features of the field, at least not at depths above 5,000 feet. The only producing well is on the south limb of a southeasterly trending anticline that was faulted and tightly folded during Miocene time; folding continued up to the Holocene. The producing zone consists of a Miocene sand referred to as Bouquet Canyon which appears to be of limited extent, probably because of poor oil saturation and of permeability and porosity changes over short distances.—MCM

bsolute age,
Carbon-14
Georgia,
Illinois,
P. 039
United S
genera
General list
North A
Dalryi
Glauconite
Californ
Obrad
Granite
Massach
effects
Montana
Tilling
Virginia,
effects
Igneous roc
Arizona,
Harak
Kimberl
New Me
intrusi
Interpretat
Alaska,
Karlst
Metamorph
Ontario,
04185
Meteorites
Hypersth
04184
Minerals
Colorado
Davis,
Ore deposit
British C
Chrism
Utah, Bi
Potassium
Hawaiian
marine
Sediments
Californi
J. Patr
bsolute age,
Carbon-14
Quaterna
E. 039
General
Handboo
Eric I.
Potassium
Glauconi
03987
Quaterna
E. 039
Quaterna

INDEX

[The numbers refer to entries in the abstracts]

Absolute age, dates
Carbon-14
Georgia, coastline deposits: Hoyt, J. H. 03977
Illinois, late-Altonian sequence: Kempton, J. P. 03979
United States, southwestern, alluvial material, general listing: Haynes, C. V., Jr. 03980
General listing
North America, Quaternary, selected: Dalrymple, G. B. 03993
Glauconite
California, San Pedro Formation, K-Ar: Obradovich, J. D. 03987
Granite
Massachusetts, Cape Ann Granite, weathering effects: Bottino, Michael L. 04497
Montana, Boulder batholith emplacement: Tilling, Robert I. 04441
Virginia, Petersburg Granite, weathering effects: Bottino, Michael L. 04497
Igneous rocks
Arizona, Santa Rita Mountains: Drewes, Harald. 04108
Kimberlite: Dawson, J. B. 04228
New Mexico, Pajarito Mtn., alkaline intrusives: Kelley, Vincent C. 04296
Interpretation
Alaska, Cook Inlet, Quaternary, correlation: Karlstrom, T. N. V. 03991
Metamorphic rocks
Ontario, Grenville province: Krogh, T. E. 04185
Meteorites
Hypersthene chondrites, Rb-Sr: Gopalan, K. 04184
Minerals
Colorado, Eldora-Jamestown area, zircons: Davis, G. L. 04522
Ore deposits
British Columbia, Craigmont, Rb-Sr: Chrismas, L. 04138
Utah, Bingham: Moore, W. J. 04239
Potassium-argon
Hawaiian Islands area, illite, authigenic marine: Moberly, Ralph, Jr. 04282
Sediments
California, Colorado River delta: Muffler, L. J. Patrick. 04462

Absolute age, methods
Carbon-14
Quaternary deposits, limitations: Damon, P. E. 03948
General
Handbook, Russian translation: Hamilton, Eric I. 04561
Potassium-argon
Glauconite, criteria for use: Obradovich, J. D. 03987
Quaternary deposits, limitations: Damon, P. E. 03948
Quaternary rocks: Dalrymple, G. B. 03993
Absolute age, methods
Rubidium-strontium
Sulfide ores, Quebec, Noranda district: Reesman, R. H. 04523
Uranium-lead
Zircon, effects of metamorphism: Davis, G. L. 04522

Alabama
Areal geology
General: Joiner, Thomas J. 04264
Economic geology
Asbestos, talc, Tallapoosa and Chambers Counties: Neathery, Thornton L. 04323
Petroleum and natural gas, 1965-66: White, H. Gene. 04301
Petroleum and natural gas, fields and possibilities: Joiner, Thomas J. 04264
Maps, oil and gas
General: White, H. Gene. 04301
Mineralogy
Asbestos, talc, Tallapoosa and Chambers Counties: Neathery, Thornton L. 04323
Paleoecology
Eocene-Oligocene, Bryozoa, St. Stephen area: Askren, L. T., Jr. 04099
Petrology
Tallapoosa and Chambers Counties, mafic-ultramafic belt, alteration: Neathery, Thornton L. 04323

Alaska
Absolute age
Cook Inlet, Quaternary deposits, interpretation: Karlstrom, T. N. V. 03991
Areal geology
Brooks Range, Lake Peters area: Reed, Bruce L. 04488
Earthquakes
March 28, 1964, effects, Anchorage area, quick-clay slides: Kerr, Paul F. 04194
Seismicity: U.S. Bureau of Reclamation. 04180
Seismicity, Katmai National Monument, since 1912: Ward, P. L. 04480
Engineering geology
Landslides, Anchorage area, quick clay slides: Kerr, Paul F. 04194
Geochemistry
Slana area, geochemical prospecting: Richter, Donald H. 04058
Maps, geochemical
Slana area, gold, base metals: Richter, Donald H. 04058
Maps, geologic
Lake Peters area, Brooks Range: Reed, Bruce L. 04488
Paleontology
Lichens, Cenozoic, geographic distribution: Krog, Hildur. 04410
Stratigraphy
Quaternary, Cook Inlet, correlation, radiometric dates: Karlstrom, T. N. V. 03991

Alaska
Volcanology
Katmai National Monument, volcanic and seismic activity: Ward, P. L. 04480
Katmai range, magma reservoirs, evidence: Kubota, S. 04479

Alberta
Economic geology
Oil sands, occurrence, genesis: Vigrass, laurence W. 04511
Petroleum, Rainbow Lake field, occurrence: Langton, J. Roger. 04508
Petroleum, Zama area, occurrence: McCamis, John G. 04507
Zinc, lead, Rocky Mountains: Evans, T. L. 04222
Geochemistry
Waterton Lakes–Flathead River Valley, Precambrian argillites, trace elements: Leask, D. M. 04086
Glacial geology
Banff area, major ice advances, features: Rutter, N. W. 04091
Paleontology
Foraminifera, Carboniferous, Etherington Formation, correlation: Mamet, Bernard L. 04097
Petrology
Northeastern, cataclastic rocks: Watanabe, R. Y. 04092
Sedimentary petrology
Cold Lake area, Mannville Group: Clack, W. J. F. 04083
Eastend and Whitemud Formations, mineralogy, provenance: Byers, P. R. 04082
Red Deer Valley, Edmonton Formation, Upper Member, sandstones: Chi, B. L. 04063
Stratigraphy
Carboniferous, Etherington Formation, Foraminifera: Mamet, Bernard L. 04097
Cretaceous, Whitemud and Eastend Formations: Byers, P. R. 04082
Devonian, Keg River Formation, Rainbow Member, Rainbow Lake area: Langton, J. Roger. 04508
Devonian, Middle facies, Zama area: McCamis, John G. 04507
Nomenclature, rules, Alberta Soc. Petroleum Geologists: Hawryszko, J. W. 04079
Precambrian, Old Fort Point Formation, Jasper area: Weiner, J. L. 04093
Quaternary, Banff area: Rutter, N. W. 04091
Structural geology
Jasper area, folds, faults, Laramide orogeny: Weiner, J. L. 04093
Nordegg area, Brazeau Range anticline, kinematic analysis: Cruden, D. M. 04064

Aluminum
Geochemistry
Soils, exchange capacity, drying effects: Westfall, Dwayne Gene. 04448

Anthozoa
Devonian
Ohio, Tenmile Creek Dolomite, rugose and tabulate: Stumm, Erwin C. 04202
Heliophyllum rhopaliseptatum, n.sp.
Devonian, Ohio, Tenmile Creek Dolomite: Stumm, Erwin C. 04202
Quaternary
Florida, Key Largo Limestone, outer and back reefs: Hoffmeister, J. E. 04292
Rugosa
Devonian, Canada, northwestern, taxonomy: Crickmay, C. H. 04157
Tabellaephyllum? phaceloidea, n.sp.
Devonian, Ohio, Tenmile Creek Dolomite: Stumm, Erwin C. 04202
Taxonomy
Devonian, Canada, northwestern: Crickmay, C. H. 04157
Zonophyllum lucasense, n.sp.
Devonian, Ohio, Tenmile Creek Dolomite: Stumm, Erwin C. 04202

Arctic
Geophysical surveys
Ice caps, heat flow, thermal probe, description: Aamot, Haldor W. C. 04156
Paleoclimatology
Pleistocene, ice-free ocean, control of glacial stages: Donn, William L. 04166
Quaternary, relative thermoluminescence as indicator: Ronca, Luciano B. 04012
Sedimentary petrology
Baffin Bay, sediments: Blee, John J. 044[illegible]

Arctic Ocean
Glacial geology
Pack ice, effect on air temperature and glaciation: Fletcher, J. O. 04165

Arizona
Absolute age
Kana-a lava flow, thermoluminescence method: Aitken, M. J. 03971
Santa Rita Mountains, igneous rocks: Drewes, Harald. 04108
Areal geology
Beaver Creek experimental drainage basin: Beus, Stanley S. 04393
Wet Beaver Creek Canyon: Thompson, Robert. 04394
Economic geology
Copper, hydrothermal alteration: Guilbert, John M. 04139
Copper, San Manuel district: Lowell, J. David. 04123
Copper, skarn deposits: Titley, Spencer R. 04155
Petroleum, Dineh bi Keyah field, occurrence, production: McKenny, Jere W. 04514
Geochemistry
San Francisco Peaks, volcanics, chemical variations: Deal, Edmond G. 04392
Geophysical surveys
Ajo porphyry copper deposit, magnetic properties: May, Bruce Tipton. 04546

Arizona
Glacial geology
San Francisco Peaks, multiple Pleistocene events: Updike, Randall G. 04391
Maps, gravity
Maricopa, Pima, Pinal, Yuma Counties, parts: Peterson, Donald L. 04189
Paleomagnetism
Holocene, basalt, Flagstaff area: Strangway, David W. 04285
Paleontology
Flora, Devonian: Canright, James E. 04386
Mammalia, Quaternary, southeastern, rodent: Cantwell, R. J. 04389
Mollusca, Quaternary, lake sediments, Winona area: Batchelder, George L. 04388
Reptilia, Mesozoic, northern, dinosaurs, popular account: Breed, William J. 04337
Petrology
Hopi Buttes, volcanic rocks, differentiation, X-ray fluorescence study: Laidley, Richard A. 04273
Sedimentary petrology
East-central, Devonian rocks, environments, provenance: Pine, Gordon Leroy. 04542
Yavapai County, stream sands, heavy minerals: Gambell, Neil. 04397
Stratigraphy
Devonian, east-central, paleogeography: Pine, Gordon Leroy. 04542
Mesozoic, northern, popular account: Breed, William J. 04337
Santa Rita Mountains, new and revised formations: Drewes, Harald. 04108
Structural geology
Coconino County, Woods Canyon drainage basin: Scholtz, Judith Fessenden. 04395
Goldfield and Superstition Mountains area, calderas: Sheridan, Michael F. 04398
Arkansas
Paleontology
Conodonts, Ordovician-Silurian, Batesville district: Craig, William Warren. 04534
Stratigraphy
Ordovician-Silurian, Batesville district: Craig, William Warren. 04534
Arsenic
Ontario
Cobalt district, genesis: Petruk, William. 04227
Cobalt-Gowganda area, occurrence: Petruk, William. 04130
Artifacts
Age
Pottery, thermoluminescence dating, progress: Ralph, Elizabeth K. 03972
Asbestos
Alabama
Tallapoosa and Chambers Counties, anthophyllite, occurrence: Neathery, Thornton L. 04323
Associations
Alberta Society of Petroleum Geologists
Stratigraphic Nomenclature Committee, rules: Hawryszko, J. W. 04079
Associations
American Assoc. Petroleum Geologists
Rocky Mountain Section, Ann. Mtg., 17th: Warner, M. A. 04489
Geol. Soc. America, Southeastern Sec.
Symposium, Tertiary sea-level fluctuations: Tanner, William F. 04015
INQUA-NCAR
Symposium, climatic change, causes: Mitchell, J. Murray 04161
Internat. Assoc. Quaternary Research
Quaternary, correlation methods, symposium: Morrison, Roger B. 03988
NATO Advanced Research Institute
Conference, thermoluminescence of geologic materials: McDougall, David J. 03981
Atlantic Coastal Plain
Paleontology
Pelecypoda, Tertiary, alticostate venericards, evolution: Heaslip, William Graham. 04377
Atlantic Ocean
Geomorphology
Lower Continental Rise Hill province, anti-dunes: Fox, P. J. 04492
North American Basin, physiographic provinces: Pratt, Richard M. 04519
Maps, bathymetric
North American Basin: Pratt, Richard M. 04519
Paleoclimatology
Quaternary, evolution of bottom water, sediments: Worthington, L. V. 04163
Quaternary, insolation, surface temperature, sea level correlation: Broecker, Wallace S. 04172
Quaternary, salinity and temperature, role in glaciation: Weyl, Peter K. 04162
Petrology
Mid-Atlantic Ridge, 22° N. lat., basalt, green schist: Melson, W. G. 04367
Sedimentary petrology
North American Basin, sediments: Pratt, Richard M. 04519
Atmosphere
Composition
Quartz in airborne dust, evaluation, X-ray diffraction: Oberg, Maurice. 04356
Bacteria
Sediment decomposition
Marine, organic debris, summer and winter: Seki, H. 04471
Barite
New Brunswick
Memramcook East and Upper Dorchester areas, occurrence, possibilities: Hamilton, J. B. 04343
Ore deposits, general
United States, central: Heyl, Allen V. 04238
Basins, structural
Sedimentation
Continental margin, Nova Scotia, mid-Tertiary: Bartlett, Grant A. 04404

Batholiths
Montana
Boulder batholith, emplacement time span: Tilling, Robert I. 04441
Petrology
Colorado–Wyoming, Precambrian Sherman Granite: Eggler, D. H. 04295
Beryllium
Colorado
Lake George area, exploration, occurrence: Hawley, C. C. 03998
Wyoming
Wind River Mountains, occurrence: Proctor, Paul Dean. 04126
Bibliography
Authors
Bevan, Arthur Charles: Leighton, Morris M. 04350
Canada
Hudson Bay Lowlands, general: Norris, A. W. 04266
Helium
Occurrence: Lipper, Harold W. 04104
Niobium
Geochemistry: Parker, Raymond L. 04103
Photogeology
Interpretation techniques, remote imaging data: Holmes, Robert F. 04183
Tantalum
Geochemistry: Parker, Raymond L. 04103
Thermoluminescence
Geological materials: Grogler, Norbert. 03955
Biogeochemical prospecting
Soil sampling
Humus, A horizon: Boyle, R. W. 04232
Biography
Bevan, Arthur Charles
Bibliography: Leighton, Morris M. 04350
Carpenter, Everett: McMurtry, Wilbur E. 04306
Jordan, Louise: Nicholson, Alex. 04515
Pemberton, John Roy: Steiny, Homer. 04516
Shead, Arthur Curtis: Oklahoma Geological Survey. 04342
Boron
Abundance
Shale, Colorado: Cody, Robert Dow. 04532
Brachiopoda
Cloudothyris postovalis, n.gen., n.sp.
Devonian, New York, Bois Blanc Formation: Boucot, A. J. 04114
Devonian
New York, Bois Blanc Formation: Boucot, A. J. 04114
Ordovician
Wyoming, Bighorn Formation: Macomber, Richard Wiltz. 04540
Pennsylvanian
Yukon, spiriferids: Gorveatt, A. C. 04085
Permian
Yukon, spiriferids: Gorveatt, A. C. 04085
Breccia
Dissolution
Terminology: Bryner, Leonid. 04119
Brines
Northwest Territories
Properties, Pine Point, fluid inclusions: Roedder, Edwin. 04231
British Columbia
Economic geology
Zinc, Big Ledge deposit, genesis: Raham, G. O. 04088
Zinc, lead, Rocky Mountains, eastern: Evans, T. L. 04222
Engineering geology
Highways, Trans-Canada Highway, Burnaby Freeway, sensitive clay: Hoy, E. M. 04251
Geochemistry
Bluebell mine, fluid inclusions: Ohmoto, Hiroshi. 04153
Craigmont, isotopes: Chrismas, L. 04138
Departure Bay sediments, organic debris, decomposition: Seki, H. 04471
Waterton Lakes–Flathead River Valley, Purcell Mts., Precambrian argillites: Leask, D. M. 04086
Paleontology
Foraminifera, Carboniferous, Lower, Connor Lakes, zonation: Mamet, B. L. 04061
Stratigraphy
Cambrian, Hamill Group, northern Dogtooth Mts.: Ellison, A. H. 04084
Carboniferous, Connor Lakes area, Foraminifera, correlation: Mamet, B. L. 04061
Cretaceous, northeastern, Tetsa–LaBiche Rivers area: Stott, D. F. 04070
Ordovician–Silurian, Peace to Muskwa Rivers: Davies, E. J. L. 04065
Triassic, Halfway Formation, Milligan Creek area: Mothersill, John S. 04078
Structural geology
Dogtooth Range, northern, folds: Wind, G. 04090
Bryozoa
Meekopora
Mississippian, Tennessee, Warsaw Limestone: McKinney, Frank K. 04100
Tertiary
Alabama, paleoecology, indicators: Askren, L. T., Jr. 04099
Cadmium
Geochemistry
Biologic concentration: Boyle, R. W. 04234
California
Absolute age
Glauconite, San Pedro Formation, K–Ar: Obradovich, J. D. 03987
Mount Lassen, 1915 flow, thermoluminescence method: Aitken, M. J. 03971
Salton Trough, Colorado River delta sediments: Muffler, L. J. Patrick. 04462
Earthquakes
1966, Parkfield sequence, mechanism, Love-wave spectra: Filson, John R. 04044
June 1966, Parkfield, mechanism: Aki, Keiti. 04042

California
Earthquakes
June 1966, Parkfield–Cholame, aftershocks, spatial distribution: Eaton, Jerry P. 04043
Economic geology
Mercury, gold, Wilbur Springs: Joralemon, Peter. 04240
Natural gas, Rio Vista field: Burroughs, Ernest. 04419
Petroleum, Bouquet Canyon field: Zulberti, J. L. 04423
Petroleum, natural gas, Brea–Olinda field: Gaede, Verne F. 04418
Petroleum, Northwest Lost Hills field: Hardoin, John L. 04421
Petroleum, Ojai field, Sisar Creek area: Mitchell, William Spencer. 04420
Petroleum, Rosedale field, north, south, east areas: Beecroft, G. W. 04422
Engineering geology
Earthquakes, San Francisco Bay area, urban development of fault zones: Cluff, Lloyd S. 04051
Geologic hazards, San Francisco Bay area, need for urban geologists: Pestrong, Raymond. 04248
Urban development, sand and gravel pits: Young, Eleanor. 04247
Geochemistry
Kings Canyon, Sequoia, and Yosemite Parks, lake waters: Bradford, G. R. 04472
Wilbur Springs, mercury, gold: Joralemon, Peter. 04240
Geomorphology
Black Mountain, Blackhawk slide, mechanism: Shreve, Ronald L. 04299
Cholame–Camp Dix area, offset stream channels, San Andreas fault: Wallace, Robert E. 03952
La Jolla submarine fan–valley: Shepard, Francis P. 04552
Mitchell Caverns, history of formation: Taylor, Frank. 04563
Southeastern, alluvial fans, steady–state relations: Hooke, Roger LeB. 04442
Geophysical surveys
Diablo and Gabilan Ranges, San Andreas fault area, seismic, crustal study: Stewart, Samuel W. 04055
Gabilan Range, Salinas area, seismic, stress accumulation at depth: Eisler, Joseph D. 04052
San Andreas fault, central, aeromagnetic, gravity: Hanna, William F. 04031
San Bruno–Hollister area, San Andreas fault, piezomagnetic changes: Breiner, Sheldon. 04033
San Jose area, Calaveras, Hayward, Silver Creek faults, aeromagnetic, gravity: Robbins, Stephen L. 04032
Sierra Nevada, heat flow: Lachenbruch, Arthur H. 04287
Glacial geology
Sierra Nevada, icecap, three million year old till: Curry, Robert R. 04246

California
Maps, geologic
Adelaida quadrangle: Durham, David L. 04212
Fox Mountain quadrangle: Vedder, J. G. 04414
Lucerne Valley, Blackhawk landslide area: Shreve, Ronald L. 04299
Maps, oil and gas
Rio Vista gas field: Burroughs, Ernest. 04419
Maps, structure
Bouquet Canyon oil field, top of Miocene: Zulberti, J. L. 04423
Brea–Olinda field, top of Miocene zones: Gaede, Verne F. 04418
Northwest Lost Hills oil field, top of Reef Ridge shale: Hardoin, John L. 04421
Ojai oil field, Sisar Creek area, top of Miocene unconformity: Mitchell, William Spencer. 04420
Rosedale oil field, north, south, east areas: Beecroft, G. W. 04422
Maps, tectonic
Faults, active, historically and recently: Stanford Univ. School Earth Sci. 03956
Paleoclimatology
Quaternary, Wisconsinan, Searles Lake: Smith, G. I. 03975
Paleontology
Cretaceous–Eocene, Salinas reservoir to Big Pine fault, table: Vedder, John G. 04056
Foraminifera, Quaternary, Tomales Bay, benthonic: Maurer, Don. 04407
Mammalia, Pleistocene, Palm Springs Formation, porcupine: White, John A. 04335
Mollusca, Jurassic–Pleistocene, San Diego County, guide: Moore, Ellen J. 04354
Mollusca, Oligocene–Miocene, Carrizo Plain–Temblor Range, correlation: Addicott, Warren O. 04037
Palynomorphs, Tertiary, San Joaquin Valley, catalog: Traverse, A. 04328
Petrology
Sierra Nevada batholith, melting relation, experimental: Piwinskii, A. J. 04433
Sedimentary petrology
Central, San Andreas fault zone, Santa Clara Formation, facies: Cummings, Jon C. 04053
Colorado River delta, sediments, composition, provenance: Muffler, L. J. Patrick. 04462
Fort Bragg area, podzolic soils, genesis: Gardner, Robert Alexander. 04446
Gualala area, Stewarts Point, Anchor Bay, German Rancho rocks: Wentworth, Carl M. 04036
La Jolla submarine canyon and fan, sediments, magnetic fabric: Rees, Anthony I. 04425
Southern, Paleogene conglomerates, tuff clasts, source: Woodford, A. O. 04291
Stratigraphy
Cenozoic, Santa Clara Formation, central, facies: Cummings, Jon C. 04053

California

Stratigraphy

Cretaceous, Franciscan coastal belt units, Cape Mendocino area: Nason, Robert D. 04030

Cretaceous, Upper, evidence of large post-Cretaceous fault slip: Hill, Mason L. 04035

Cretaceous–Eocene, relations along Nacimiento fault: Vedder, John G. 04056

Cretaceous–Quaternary, Adelaida quadrangle, section: Durham, David L. 04212

Cretaceous–Quaternary, Fox Mtn. quadrangle, sections: Vedder, J. G. 04414

Cretaceous–Tertiary, Gualala area, post-Cretaceous fault slip evidence: Wentworth, Carl M. 04036

Miocene, Caliente Range, southeastern, fault effect on sedimentation: Clifton, H. Edward. 04040

Miocene, phosphatic facies, San Andreas fault area, correlation: Dickert, Paul F. 04039

Oligocene–Miocene, Carrizo Plain–Temblor Range, correlation across fault: Addicott, Warren O. 04037

Quaternary, Sierra Nevada, correlation with Lake Lahontan area: Birkeland, P. W. 03976

Quaternary, Wisconsin sediments, Searles Lake basin, paleoclimatology: Smith, G. I. 03975

Tertiary, lower, Santa Cruz Mts. area, correlation across fault: Clark, Joseph C. 04038

Structural geology

Caliente Range, southeastern, San Andreas fault, Miocene movement: Clifton, H. Edward. 04040

Cape Mendocino area, San Andreas fault, relation to fracture zones: Nason, Robert D. 04030

Carrizo Plain–Temblor Range segment of San Andreas fault, Tertiary movement: Addicott, Warren O. 04037

Central, San Andreas fault, post-Pliocene movement: Cummings, Jon C. 04053

Cholame and Taft–Maricopa areas, San Andreas fault, deformation: Howard, John H. 04047

Cholame–Camp Dix area, San Andreas fault, stream channel displacements: Wallace, Robert E. 03952

Coast Ranges, squeezing between granitic blocks, high fluid potentials: Berry, Frederick A. F. 04048

Gualala area, San Andreas fault, post-Cretaceous slip: Wentworth, Carl M. 04036

Hayward, Calaveras, Pleasanton faults, activity, history: Radbruch, Dorothy H. 04050

Hollister area, San Andreas and Calaveras fault zones, recent movement: Rogers, Thomas H. 04049

Kern River fault, strains, observations: Vali, V. 04364

California

Structural geology

Mojave Desert, faults, northwest-trending, relation to San Andreas: Troxel, Bennie W. 04019

Nacimiento fault, Salinas reservoir to Big Pine fault: Vedder, John G. 04056

Owens Valley fault zone, right-lateral movement and creep: Bonilla, Manuel G. 03957

Owens Valley fault zone, vertical movement: Oliver, H. W. 04029

Paicines–Camp Dix area, San Andreas fault, recent movement: Brown, Robert D., Jr. 03953

Pajaro Gap, San Andreas fault, movement, evidence, Franciscan rocks: Maddock, Marshall E. 04034

Peninsular Ranges, San Andreas fault system and earlier structures: Sharp, Robert V. 04023

Salinas area, San Andreas fault, stress accumulation at depth: Eisler, Joseph D. 04052

San Andreas and Garlock faults, displacements, schist bodies: Ehlig, Perry L. 04024

San Andreas fault, large post-Cretaceous slip: Hill, Mason L. 04035

San Andreas fault, large slip, evidence, evaluation: Gastil, R. Gordon. 04054

San Andreas fault, Miocene movement: Dickert, Paul F. 04039

San Andreas fault, stress changes at depth, piezomagnetic effects: Breiner, Sheldon. 04033

San Andreas fault system, active, inactive areas, tectonic environments: Allen, Clarence R. 04041

San Andreas fault system, geologic problems, conference: Stanford Univ. School Earth Sci. 03956

San Andreas fault system, large-scale displacements, pre-Cretaceous rocks: Silver, Leon T. 04018

San Andreas fault system, movement, recent changes: Hofmann, Renner B. 04046

San Andreas fault system, recent strain from triangulation surveys: Burford, Robert O. 04045

Santa Cruz Mountains area, San Andreas fault, post-Eocene movement: Clark, Joseph C. 04038

Southern, tectonic evolution: Yeats, Robert S. 04025

Tectonic history, relation to East Pacific Rise: Crowell, John C. 04026

Tectonics, Cenozoic, relation to Pacific basin: Hamilton, Warren B. 04027

Transverse Ranges, San Andreas fault system: Dibblee, Thomas W., Jr. 04017

Cambrian

British Columbia

Dogtooth Mountains, northern, Hamill Group: Ellison, A. H. 04084

Cambrian
Newfoundland
New World Island, Trilobita: Kay, Marshall, 04443
Northwest Territories
Mackenzie Mountains, southern, Sekwi Formation: Handfield, R. C. 04072
Canada
Areal geology
Hudson Bay Lowlands: Sanford, B. V. 04265
Economic geology
Petroleum, western, occurrence, selected papers: Warner, M. A. 04489
Engineering geology
Clays, eastern, Leda clay, properties: Crawford, Carl B. 04195
Soil mechanics, spiral-ft settlement gage: Bozozuk, M. 04261
General
Bibliography, Hudson Bay Lowlands: Norris, A. W. 04266
Maps, geologic
Hudson Bay Lowlands: Sanford, B. V. 04265
Paleontology
Anthozoa, Devonian, northwestern, taxonomy: Crickmay, C. H. 04157
Cephalopoda, Silurian, *Discosorus-Huronia* faunas, James Bay lowland: Flower, Rosseau H. 04381
Petrology
Shield, Precambrian: Wilson, M. E. 04374
Stratigraphy
Cretaceous, Mannville Group, western Canada basin: Vigrass, Laurence W. 04511
Mississippian, western, relation to Williston basin: Proctor, Richard M. 04509
Precambrian, shield: Wilson, M. E. 04374
Triassic-Jurassic, western: Carlson, C. E. 04510
Structural geology
Shield, Precambrian, general: Wilson, M. E. 04374
Carbon
Geochemistry
Diamonds, genesis: Kennedy, George C. 04229
Isotopes
C-14, cosmogenic, variations, climatic changes: Suess, Hans E. 04173
C-12, marine plankton, enrichment: Degens, E. T. 04440
C-13, metabolic fractionation in marine plankton: Degens, E. T. 04439
Fractionation, graphite-calcite-methane-carbon dioxide: Bottinga, Yan. 04545
Ratios, British Columbia: Chrismas, L. 04138
Carboniferous
Alberta
Southwestern, Etherington Formation, Foraminifera: Mamet, Bernard L. 04097
British Columbia
Connor Lakes area, Foraminifera, Lower, correlation: Mamet, B. L. 04061
Carboniferous
British Columbia
Correlation, thickness, distribution, Lower: Mamet, B. L. 04061
Caribbean region
Paleontology
Foraminifera, Eocene, orbitolinids, taxonomic revision: Butterlin, Jacques. 04324
Caves
California
Mitchell Caverns, history of formation: Taylor, Frank. 04563
Features
Geometry, changing, solution processes: Lange, Arthur L. 04353
Cenozoic
Alaska
Lichens, geographic distribution: Krog, Hildur. 04410
California
Central, Santa Clara Formation: Cummings, Jon C. 04053
San Diego County, Mollusca, collecting guide: Moore, Ellen J. 04354
Correlation
Pliocene-Pleistocene events, geomagnetic reversals: Glass, Billy Price. 04537
Greenland
Sea-level changes, glacioeustatic, Plio-Pleistocene boundary: Mercer, John H. 04057
Mexico
Baja California, Mollusca, diatoms: Hertlein, Leo G. 04300
Paleoclimatology
Cooling trend, causes: Hamilton, Warren. 04170
Palynology
Catalog: Traverse, A. 04328
United States
Northwestern, mesa basalt sheet: Wheeler, H. E. 04481
Southeastern, sea-level fluctuations: Alt, David. 04014
Wyoming
Western, tectonics: Crosby, Gary W. 04512
Central America
Volcanology
Circum-Caribbean region, magma similarity: Weyl, R. 04482
Cephalopoda
Farroceras liskeardense, n.gen., n.sp.
Silurian, Ontario, Haileybury area, Farr Formation: Flower, Rosseau H. 04381
Narthecoceratidae
Ordovician-Silurian, North America, taxonomy, revision: Flower, Rosseau H. 04381
Silurian
Canada, James Bay lowland, *Discosorus-Huronia* faunas: Flower, Rosseau H. 04381

Cesium
Isotopes
Transport in clay suspensions, model river system: Purushothaman, Krishnier. 04528

Changes of level
Florida
Florida Keys, possible tilting: Hoffmeister, J. E. 04292
Georgia
Pleistocene, shorelines, dating: Hoyt, J. H. 03977
Greenland
Glacioeustatic, Plio–Pleistocene boundary: Mercer, John H. 04057
Gulf of Panama
Holocene sea–level rise: Golik, Abraham. 04429
North America
Tertiary sea–level fluctuations: Tanner, William F. 04015
South Carolina
Tertiary, sea–level fluctuations, history: Colquhour., D. J. 04009
Texas
Tertiary, sea–level fluctuations: Wilson, John A. 04007
United States
Cenozoic, southeastern: Alt, David. 04014
Holocene, Atlantic coast: Newman, Walter S. 04551
Tertiary, Cape Cod to Cape Hatteras, tectonic control: Richards, Horace G. 04010
Tertiary, southeastern, sea level, multiple influences: Tanner, William F. 04008
Worldwide
Tertiary fluctuations, glacial control: Bandy, Orville L. 04016

Chemical analysis
Reflectometry
Gold, fineness: Eales, Hugh V. 04120
Sample preparation
Estuary sediments and water, trace element exchange: Duke, Thomas W. 04496
Lake waters, trace elements for spectrographic analysis: Bradford, G. R. 04472
Tracer technique
Sulfur, partial pressure: Giletti, B. J. 04137
Volumetric
Nitrates in saline minerals: Reichen, Laura E. 04002
Wet
Chelation–extraction, Pb, Co, Ni in fresh water: Fishman, Marvin J. 04308
Gold, mercurous chloride: Jenne, E. A. 04225
Molybdenum, field kit: Barakso, John. 04118
Molybdenum, field kit: Lapointe, Guy. 04241

Chesapeake Bay
Sedimentary petrology
Northern, suspended sediment, mineral composition, size analysis: Schubel, Jerry Robert. 04548

Cirripedia
Balanus humilis Conrad
Miocene, Florida, phosphatized internal filling, identity obscure: Ross, Arnold. 04199

Clay mineralogy
Areal studies
Gulf of Mexico, cores: Scafe, Donald William. 04547
Hawaiian Islands, authigenic marine: Moberly, Ralph, Jr. 04282
Manitoba, Winnipeg area, swelling clay soils: Quigley, Robert M. 04260
Maryland, Baltimore area, schist, silicate–water interaction: Bricker, Owen P. 04307
Nevada, Lander County, adsorption, copper: Clement, Stephen C. 04237
New Brunswick, Podzol soils: Kodama, H. 04330
Ohio, western, Celina and Morley soils, argillic horizons: Smeck, Neil E. 04193
Utah, Kane Creek, uranium–bearing veins: Davidson, Donald M., Jr. 04293
Experimental studies
Clay suspensions, Sr and Cs transport, model river system: Purushothaman, Krishnier. 04528
Montmorillonite, flow properties, changes with reduction: Alcordo, Isabelo Suelo. 04445
Montmorillonite group, low temperature synthesis: Levinson, A. A. 04521
Montmorillonite, manganese reactions, soil organic material: Rosell, Ramon Antonio. 04447
Organic complexes, cation–dipole interactions: Bissada, Kadry Kaddis. 04530
Shale, ion exchange capacity: Williams, H. H. 04089
Thermoluminescence, firing changes, age determination: Siegel, Frederic R. 03954

Clays
Canada
Ottawa–Saint Lawrence valleys, properties: Crawford, Carl B. 04195
Kentucky
Hardin quadrangle, occurrence: Scott, Glenn R. 04159
Oak Level quadrangle, occurrence: Olive, Wilds W. 04204
Properties
Shear strength, consolidation of soft sensitive, new concepts: Kenney, T. Cameron. 04259
Quebec
Properties, shear strength of sensitive: Ladanyi, B. 04257

Coal
Colorado
Corral Bluffs quadrangle, occurrence: Soister, Paul E. 04411
Kentucky
Majestic, Hurley, Wharncliffe quadrangles: Outerbridge, William F. 04412

Coal
Properties
Proton magnetic relaxation, bituminous: Retcofsky, H. L. 04490
Virginia
Bramwell (W.Va.) area, Pocahontas Formation: Englund, Kenneth J. 04205
West Virginia
Bramwell area, Pocahontas Formation: Englund, Kenneth J. 04205

Cobalt
Analysis
Atomic absorption spectroscopy, water, chelation extraction: Fishman, Marvin J. 04308
Ontario
Cobalt district, genesis: Petruk, William. 04227
Cobalt–Gowganda area, occurrence: Petruk, William. 04130

Colorado
Absolute age
Eldora–Jamestown area, zircon, effect of metamorphism: Davis, G. L. 04522
Earthquakes
1962–67, Denver area, relation to Rocky Mtn. Arsenal well: Hollister, John C. 04310
Economic geology
Beryllium, tungsten, tin, Lake George area: Hawley, C. C. 03998
Coal, gravel, Corral Bluffs quadrangle: Soister, Paul E. 04411
Metals, Leadville, Gilman: Titley, Spencer R. 04155
Mineral resources, Jefferson County, Mt. Carbon Reservoir site: Smith, Joseph B. 03999
Natural gas, Greenwood field: Wingerter, H. R. 04464
Engineering geology
Reservoirs, Jefferson County, Mt. Carbon site: Smith, Joseph B. 03999
Geochemistry
Lake George area, geochemical prospecting, Be, Sn, W: Hawley, C. C. 03998
Paleozoic shales, boron abundances: Cody, Robert Dow. 04532
Rabbit Ears Range, Poison Ridge stock, geochemical prospecting: Kinney, Douglas M. 03994
Glacial geology
Front Range, Holocene history, lichen growth rates: Benedict, James B., Jr. 04529
Maps, geologic
Corral Bluffs quadrangle: Soister, Paul E. 04411
Virginia Dale area: Eggler, D. H. 04295
Maps, gravity
Trinidad quadrangle: Peterson, D. L. 04408
Petrology
Rabbit Ears Range, Poison Ridge porphyry: Kinney, Douglas M. 03994
Virginia Dale ring-dike complex: Eggler, D. H. 04295

Colorado
Stratigraphy
Cretaceous–Quaternary, Corral Bluffs quadrangle, section: Soister, Paul E. 04411
Devonian, western, biostratigraphy: Pampe, William Riley. 04541
Structural geology
Cordilleran foreland, tectonics, mechanics: Sales, John K. 04513

Connecticut
Areal geology
Long Hill and Bridgeport quadrangles: Crowley, William Patrick. 04302
Geochemistry
Linsley Pond, Fe-reducing environment, Eh, thermodynamic equilibrium: Doyle, Roger Whitney Stevens. 04535
Maps, geologic
Bridgeport quadrangle: Crowley, William Patrick. 04302
Long Hill quadrangle: Crowley, William Patrick. 04302
South-central: Crowley, William Patrick. 04302

Conodonts
Devonian
Nevada, Dutch John Mountain, Lincoln County: Gordon, Joan E. 04413
Ordovician
Arkansas, Batesville district, biostratigraphy: Craig, William Warren. 04534
Silurian
Arkansas, Batesville district, biostratigraphy: Craig, William Warren. 04534

Construction materials
United States
Dimension stone, occurrence, production: Barton, William R. 04105

Continental drift
Mexico
Baja California, separation, relation to East Pacific Rise: Crowell, John C. 04026
Paleoclimatology
Latitudinal asymmetry before middle Tertiary: Hamilton, Warren. 04170
Paleomagnetism
Polar wandering, relation to Quaternary glaciation: Cox, Allan. 04168

Continental margin
California
La Jolla canyon and fan, sediments, magnetic fabric: Rees, Anthony I. 04425
Southern, La Jolla submarine fan–valley: Shepard, Francis P. 04552
Mexico
Baja California, southern tip, areal geology: Normark, William R. 04297
North America
General, geophysical survey data, summary: Worzel, J. Lamar. 04559
Western, major faulting, transverse and peripheral: Burk, Creighton A. 04028

Continental margin
Nova Scotia
Slope, Oligocene–Miocene stratigraphy, paleoecology: Bartlett, Grant A. 04404
Panama
Gulf of panama, Holocene sedimentation, history: Golik, Abraham. 04429
United States
Eastern, shelf, Cretaceous–Cenozoic development: Garrison, Louis Eldred. 04536
Eastern, shelf, slope, sediments, topography: Pratt, Richard M. 04519
World
General, geophysical survey data, summary: Worzel, J. Lamar. 04559
Copper
Arizona
San Manuel district, exploration, guides: Lowell, J. David. 04123
Exploration
Geochemical prospecting: Dahlberg, Eric C. 04236
Hydrothermal alteration, zoning: Guilbert, John M. 04139
Geochemistry
Biologic concentration: Boyle, R. W. 04234
Carbonate replacement deposits: Titley, Spencer R. 04155
Haiti
Geochemistry, Meme mine, occurrence, genesis: Kesler, Stephen E. 04188
Mexico
Durango, Mapimi district, occurrence: Hoffmann, Victor J. 04131
Fresnillo, exploration: Villasenor, Luis. 04133
Metallogenetic provinces: Wilson, Ivan F. 04148
Nevada
Lander County, supergene, altered plagioclase: Clement, Stephen C. 04237
New Mexico
Red River district, occurrence: Clark, K. F. 04226
Saskatchewan
Kipahigan Lake deposit, occurrence: Netolitzky, R. K. 04087
Utah
Bingham, absolute age: Moore, W. J. 04239
Core
Processes
Kinematics, magnetic field, secular variations: Booker, John Ratcliffe. 04531
Correlation
Methods
Dendrograph, two–dimensional tool: McCammon, Richard B. 04281
Paleomagnetism, Quaternary: Cox, Allan. 03986
Quaternary, North America, symposium: Morrison, Roger B. 03988
Principles
Pleistocene, glacial deposits: Ray, L. L. 03990
Correlation
Principles
Quaternary, North America, symposium: Morrison, Roger B. 03988
Quaternary
Soil–stratigraphic units, application: Morrison, R. B. 03989
Costa Rica
Volcanology
Irazu, Poas, activity, 1964–65: Krushensky, R. D. 04478
Cretaceous
Alberta
Eastend and Whitemud Formations: Byers, P. R. 04082
Arizona
Northern, stratigraphy and paleontology, popular account: Breed, William J. 04337
Santa Rita Mountains, Fort Crittenden Formation, redefined: Drewes, Harald. 04108
British Columbia
Northeastern, Tetsa–LaBiche Rivers area, stratigraphy: Stott, D. F. 04070
California
Cape Mendocino area, Franciscan coastal belt units, stratigraphy: Nason, Robert D. 04030
Gualala area, stratigraphy: Wentworth, Carl M. 04036
Canada
Hudson Bay Lowlands, reconnaissance summary: Sanford, B. V. 04265
Western Canada basin, stratigraphy: Vigrass, Laurence W. 04511
Montana
Dawson County, pteridophytes, Hell Creek Formation: Hall, John W. 04527
Southeastern, Bell Creek oil field, Muddy Sandstone: Berg, Robert R. 04506
Southeastern, Bell Creek oil field, stratigraphy: McGregor, Alexander A. 04505
Nebraska
Denver basin, Dakota Sandstone: Exum, F. A. 04504
Saskatchewan
Eastend and Whitemud Formations: Byers, P. R. 04082
Texas
Foraminifera, *Globotruncana*, Taylor Marl: Esker, George C., 3d. 04405
Foraminifera, heterohelicid, Kemp Clay, possible index: Esker, George C., 3d. 04406
South–central, stratigraphy: Rives, John S. 04317
Crinoidea
Plummericrinus, n.spp.
Pennsylvanian, Ohio–Pa.–W. Va., Conemaugh Group: Burke, J. J. 04331
Synbathocrinus melba
Pennsylvanian, Oklahoma, Wann Formation: Strimple, Harrell L. 04341

Crust
California
Structure, Diablo and Gabilan Ranges, San Andreas fault area, seismic surveys: Stewart, Samuel W. 04055
Composition
Gold: Jones, Robert S. 04502
Structure
Mantle convection: Keith, M. L. 04117
Cryptoexplosion structures
Kentucky
Jeptha Knob, origin: Seeger, C. Ronald. 04500
Texas
Sierra Madera, structural pattern in central uplift: Wilshire, H. G. 04305
United States
Central, structural controls: Heyl, Allen V. 04238
Crystal chemistry
Apatite
Carbonate substitution: LeGeros, Racquel Zapanta. 04449
Lattice defects
Replacement, susceptibility: McDougall, David J. 04121
Silicates
Analysis, structon theory: Huggins, Maurice L. 04348
Crystal structure
Sphalerite
Colloform texture, interpretation: Roedder, Edwin. 04230
Crystallography
Twinning
Deformation twins, wedge dislocation model: Armstrong, R. W. 04074
Deformation
Experimental studies
Elasticity, model, borehole probe test, instrument: Nichols, Thomas C., Jr. 04005
Limestone, syenite, pressure effect on thermoluminescence: Morency, Maurice. 03966
Strength, compressive, diabase, water effect: Simpson, Dale R. 04304
Stress, transmission, Cordilleran foreland: Sales, John K. 04513
Field studies
Recrystallization, quartzite, cross girdle orientations: Sylvester, A. G. 04434
Strain, Kern River fault, California: Vali, V. 04364
Stress, accumulation at depth, seismic method: Eisler, Joseph D. 04052
Stress, transmission, Cordilleran foreland: Sales, John K. 04513
Theoretical studies
Twinning dislocations, wedge dislocation model: Armstrong, R. W. 04074
Devonian
Arizona
East-central, stratigraphy, paleogeography: Pine, Gordon Leroy. 04542
Devonian
Arizona
Flora: Canright, James E. 04386
Canada
Nomenclature, Hudson Bay Lowlands, new formations: Sanford, B. V. 04265
Northwestern, Anthozoa: Crickmay, C. H. 04157
Colorado
Western, biostratigraphy: Pampe, William Riley. 04541
Kentucky
Pulaski County, stratigraphy: Helton, Walter L. 04182
Michigan
Alpena area, Trilobita, Alpena Limestone: Stumm, Erwin C. 04201
Nevada
Lincoln County, Dutch John Mtn., stratigraphy, biostratigraphy: Gordon, Joan E. 04413
New York
Brachiopoda, Bois Blanc Formation: Boucot, A. J. 04114
North America
Eastern, paleogeography, Bois Blanc–Schoharie time: Boucot, A. J. 04114
Ohio
Lucas County, Anthozoa, Tenmile Creek Dolomite: Stumm, Erwin C. 04202
Sylvania area, Trilobita, Silica Shale: Stumm, Erwin C. 04201
West Virginia
Valley Head area, pteridophytes, Hampshire shale: Andrews, Henry N. 04277
Diagenesis
Experimental studies
Quartz sand, carbonate rocks: Sharma, Ghanshyam D. 04427
Sediments
Marine, organic material: Degens, E. T. 04440
Diamonds
Genesis
Environment, CO_2 role: Kennedy, George C. 04229
Review: Dawson, J. B. 04228
Diapirs
Gulf of Mexico
Sigsbee Deep to Bay of Campeche: Worzel, J. Lamar. 04465
Materials
Mexico: Salas, Guillermo P. 04147
Diatoms
Quaternary
New York, Pleistocene clay, Massena area, electron micrographs: O'Brien, Neal R. 04401
Tertiary
Mexico, Baja California, Miocene: Hertlein, Leo G. 04300
Differential thermal analysis
Data
Wavellite: Blanchard, Frank N. 04200

Differential thermal analysis
Methods
Wavellite, pattern variations, cf. other methods: Blanchard, Frank N. 04200
Dikes
Alkali-gabbroic
Flow differentiation vs. multiple injection, Greenland: Bhattacharji, Somdev. 04437
Feldspar
Hydrothermal: Randall, John A. 04197
Ring
Colorado-Wyoming, Virginia Dale complex: Eggler, D. H. 04295
District of Columbia
Mineralogy
Northwestern, chlorite-talc schist: Broughton, Paul L. 04098
Earth
Composition
Chemical processes in early solar system: Anders, Edward. 04345
Interior
Core-mantle boundary, properties from PcP phases: Buchbinder, Goetz G. R. 04366
Core-mantle interface, topography: Hide, R. 04493
Origin
Chemical processes in early solar system: Anders, Edward. 04345
Physical properties
Gross Earth data, resolving power: Backus, George. 04288
Q for upper 125 km: DeBremaecker, J. Cl. 04187
Rotation
Variation, since Late Cambrian: Pannella, Giorgio. 04494
Earthquakes
Alaska
Seismicity: U.S. Bureau of Reclamation. 04180
Seismicity, Katmai National Monument, since 1912: Ward, P. L. 04480
California
1966, Parkfield sequence, mechanism, Love-wave spectra: Filson, John R. 04044
June 1966, Parkfield, mechanism: Aki, Keiiti. 04042
June 1966, Parkfield-Cholame, aftershocks, spatial distribution: Eaton, Jerry P. 04043
Prediction, San Andreas fault, local magnetic events: Breiner, Sheldon. 04476
Colorado
1962, Denver area, relation to Rocky Mtn. Arsenal well: Hollister, John C. 04310
Distribution
Global tectonics, hypothesis: Isacks, Bryan. 04365
Effects
Landslides, Alaska, Anchorage area, quick-clay underflow: Kerr, Paul F. 04194
Elastic waves
Frequency-wave-number spectra, determination method: Iyer, H. M. 04289
Earthquakes
Elastic waves
PcP phases, core-mantle boundary properties: Buchbinder, Goetz G. R. 04366
Hawaii
Seismicity: U.S. Bureau of Reclamation. 04180
Mechanism
California, Parkfield, June 1966: Aki, Keiiti. 04042
California, Parkfield sequence, Love-wave spectra: Filson, John R. 04044
Elastodynamic source fields, theory: Archambeau, Charles B. 04094
Multipolar components, relative sizes: Randall, M. J. 04363
Stick-slip, stable sliding, and rock properties: Byerlee, James D. 04373
Nevada
1954, Dixie Valley-Fairview Peak, surface strain, energy release: Meister, Laurent J. 04370
Time distribution, tidal forces influence: Tamrazyan, Gurgen P. 04484
Prediction
Laboratory studies, current: Brace, W. F. 04477
Local magnetic events, California, San Andreas fault: Breiner, Sheldon. 04476
Microearthquake relation to large, source mechanism importance: Aki, K. 04475
Research program, planning, requirements: Press, Frank. 04474
Stress accumulation at depth, measurement, seismic method: Eisler, Joseph D. 04052
United States
1965, summary: vonHake, Carl A. 04336
1966, summary: vonHake, Carl A. 04128
Seismicity, western: U.S. Bureau of Reclamation. 04180
Echinoidea
Echinocyamus bisexus, n.sp.
Eocene, Georgia, Lake City Formation: Kier, Porter M. 04127
Leniechinus herricki, n.sp.
Eocene, Georgia, Lake City Formation: Kier, Porter M. 04127
Pentedium curator
Eocene, Georgia, Lake City Formation: Kier, Porter M. 04127
Tertiary
Georgia, Lake City Formation, Eocene, new fauna: Kier, Porter M. 04127
Ecology
Changes
Summer and winter, marine sediments, biochemical decomposition: Seki, H. 04471
Foraminifera
Littoral, California, Tomales Bay, benthonic: Maurer, Don. 04407
Marine, Gulf of Saint Lawrence, Magdalen Shallows: Vilks, G. 04403

Ecology
North America
Terrestrial, soils, plant communities: Eyre, S. R. 04129
West Indies
Marine, leeward reefs, St. Vincent: Adams, R. D. 04436
Economic geology
Practice
Geochemistry, applications: Kalliokoski, J. 04242
El Salvador
Hydrogeology
Rio Grande de San Miguel basin, ground-water development: Patchick, Paul F. 04313
Elastic properties
Compressible media
Spherical wave propagation, model: Faccioli, Ezio. 04454
Ice
Velocity anisotropy, Greenland glacier: Bennett, Hugh Frederick. 04544
Marble
Anisotropy, correlation with grain orientation, method: Klima, Karel. 04327
Elasticity
Granite
Measurements, in place cf. laboratory: Simmons, Gene. 04073
Electrical methods
Applications
Highway construction, subsurface geology: Mitchell, Robert E. 04144
Techniques
Oil prospecting: Keller, George V. 04562
Electrical properties
Granite
Resistivity, in place, measurements: Simmons, Gene. 04073
Electrical surveys
Illinois
Northeastern, sanitary landfills: Cartwright, Keros. 04269
Nevada
Sheep Creek Range, western: Gott, Garland B. 03996
Virginia City area, Comstock Lode district: Whitebread, Donald H. 03995
Electron microscopy
Applications
Palynology: Martin, Paul S. 04385
Electron spin resonance
Applications
Radiation damage detection, cf. thermoluminescence: Zeller, Edward J. 03969
Engineering geology
Applications
Urban geology, sand and gravel pits: Young, Eleanor. 04247
Clays
Canada, Ottawa–St. Lawrence valleys, Leda clay: Crawford, Carl B. 04195
Remolded, static and dynamic skin friction response: Raba, Carl Franz, Jr. 04458
Engineering geology
Clays
Shear strength, behavior of sensitive, Quebec: Ladanyi, B. 04257
Strength, consolidation, new concepts, review: Kenney, T. Cameron. 04259
Earthquakes
California, San Francisco Bay area, urban development of fault zones: Cluff, Lloyd S. 04051
Saturated sand, liquefaction, experimental: Schroeder, Warren Lee. 04459
Experimental studies
Cylindrical openings, stress distributions, models: Bohidar, Naikananda K. 04461
Saturated sand, liquefaction, seismic loading: Schroeder, Warren Lee. 04459
Sediment diffusion, nonuniform flow field: Apmann, Robert Proctor. 04460
Gas storage
Oil and gas reservoirs, factors: Goodman, J. V. 04309
General
Borehole cameras: Lundgren, Raymond. 04319
Geologic hazards
California, San Francisco Bay area, need for urban geologists: Pestrong, Raymond. 04248
Highways
British Columbia, Trans-Canada Highway, Burnaby Freeway, sensitive clay: Hoy, E. M. 04251
Geophysical techniques, subsurface geology: Mitchell, Robert E. 04144
Iowa, design, effect of peat deposits: Blattert, Robert E. 04146
Kansas, applications, review: Burgat, Virgil A. 04143
Nebraska, application, procedures: Eversoll, Duane A. 04149
Symposium, 17th annual: Lemish, John. 04142
Land subsidence
Ontario, Cornwall to Quebec border, Leda clays: Stermac, A. G. 04258
Land use
Illinois, Hennepin region: McComas, Murray R. 04318
Landslides
Alaska, Anchorage area, quick-clay slides: Kerr, Paul F. 04194
Quebec, Toulnustouc River, soil properties: Quigley, R. M. 04253
South Dakota, Pierre Shale: Bruce, Richard L. 04150
Materials, properties
Chert, morphology: Kneller, William A. 04151
Evaporites, GNOME project: Gard, Leonard M., Jr. 04059
Kentucky, Paducah West and Metropolis quadrangles: Finch, Warren I. 04004
Rock cores, evaluation techniques: Michael, Robert D. 04145

Engineering geology
Materials, properties
Strength, silty soils, field vane testing: Blight, G. E. 04250
Nuclear explosions
GNOME, effects: Gard, Leonard M., Jr. 04059
Practice
Geophysics, use and abuse: Fritz, Axel M. 04152
Reservoirs
Colorado, Jefferson County, Mt. Carbon site: Smith, Joseph B. 03999
Nebraska, Omaha area, Papillion Creek: Smith, Joseph B. 04001
Rock mechanics
Cylindrical openings, stress distributions, models: Bohidar, Naikananda K. 04461
Fracturing, waveform generation, longitudinal impact: Lyons, Charles Gene. 04457
Instruments, borehole probe, stress changes: Nichols, Thomas C., Jr. 04005
Sanitary landfills
Ground water alteration, test surveys, Illinois: Cartwright, Keros. 04269
Slope stability
Inelastic analysis, finite element method: Gates, Richard Holt. 04455
Simple cuts, clays: Hunter, John Henry. 04456
Soil mechanics
Instruments, spiral-ft settlement gage, Canada: Bozozuk, M. 04261
Soils
Preconsolidation pressures: Kenney, T. Cameron. 04249
Quebec, Outardes 2 project, properties: Sainani, U. R. 04252
Strength, silty, field vane testing: Blight, G. E. 04250
Textbook: Scott, Ronald F. 04344
Waste disposal
Illinois, criteria for wells: Bergstrom, Robert E. 04267
Rocky Mountain Arsenal well, relation to Denver earthquakes: Hollister, John C. 04310

Epeirogenesis
Periodicity
Transgressive and regressive phases, effects on climate: Damon, Paul E. 04167

Erosion
Beaches
Shore erosion, scales, Bruun effect: Schwartz, Maurice L. 04430
Controls
Paleohydrologic, plant cover effect: Schumm, S. A. 04283

Evaporites
Geochemistry
Analysis, volumetric, nitrates: Reichen, Laura E. 04002
Mexico
Caprock: Salas, Guillermo P. 04147

Evolution
General
Elementary account: Moore, Ruth. 04332
Gymnosperms
Cycadeoidales, Mesozoic, cone origin, hypotheses: Delevoryas, T. 04256
Mammalia
Tertiary, gophers, Oregon, John Day Formation: Rensberger, John Marshall. 04549
Pelecypoda
Venericardia, alticostate, Tertiary, U.S. Gulf and east coasts: Heaslip, William Graham. 04377

Faults
Experimental studies
Wrench and overthrusts, mechanism: Sales, John K. 04513
General
Alaska, Lake Peters area, history: Reed, Bruce L. 04488
California, historically and recently active, map: Stanford Univ. School Earth Sci. 03956
California, southern, borderland evolution: Yeats, Robert S. 04025
California, Transverse Ranges, movement, history: Crowell, John C. 04026
Mexico, Baja California, southern tip, continental margin: Normark, William R. 04297
Oklahoma, Red Oak-Norris gas field: Six, David A. 04303
Normal
California, Nacimiento fault, Salinas reservoir to Big Pine fault, vertical movement: Vedder, John G. 04056
Slip, determination: Lowell, J. David. 04123
Overthrust
California, Peninsular Ranges, eastern, mylonitic zone: Sharp, Robert V. 04023
Wyoming, western belt: Crosby, Gary W. 04512
Shear zones
California, San Andreas fault, relation to Mendocino and Murray: Nason, Robert D. 04030
Strike-slip
California, Hayward, Calaveras, Pleasanton faults, movement, historic: Radbruch, Dorothy H. 04050
California, Kern River fault, strain observations: Vali, V. 04364
California, Mojave Desert, northwest-trending, relation to San Andreas: Troxel, Bennie W. 04019
California, Owens Valley zone, right-lateral movement and creep: Bonilla, Manuel G. 03957
California, Owens Valley zone, vertical movement: Oliver, H. W. 04029
California, Pacific basin, tectonic relationships: Hamilton, Warren B. 04027

Faults
Strike-slip
California, San Andreas and Calaveras zones, Hollister area, recent movement: Rogers, Thomas H. 04049
California, San Andreas and Garlock, displacements, schist bodies: Ehlig, Perry L. 04024
California, San Andreas, Caliente Range, southeastern, Miocene movement: Clifton, H. Edward. 04040
California, San Andreas, Cape Mendocino area, relation to fracture zones: Nason, Robert D. 04030
California, San Andreas, central, post-Pliocene movement: Cummings, Jon C. 04053
California, San Andreas, Cholame and Taft-Maricopa areas, deformation: Howard, John H. 04047
California, San Andreas, Cholame Camp Dix area, stream channel displacements: Wallace, Robert E. 03952
California, San Andreas, Gualala area, post-Cretaceous slip evidence: Wentworth, Carl M. 04036
California, San Andreas, large post-Cretaceous slip: Hill, Mason L. 04035
California, San Andreas, large slip, evidence: Gastil, R. Gordon. 04054
California, San Andreas, Miocene movement: Dickert, Paul F. 04039
California, San Andreas, movement, Pajaro Gap, Franciscan rocks: Maddock, Marshall E. 04034
California, San Andreas, movement, prediction: Breiner, Sheldon. 04476
California, San Andreas, movement, Tertiary: Addicott, Warren O. 04037
California, San Andreas, Paicines-Camp Dix, recent movement: Brown, Robert D., Jr. 03953
California, San Andreas, Santa Cruz Mts. area, post-Eocene movement: Clark, Joseph C. 04038
California, San Andreas, stress changes at depth, piezomagnetic effects: Breiner, Sheldon. 04033
Mexico, Sonora, northwest trending, possible San Andreas extension: Merriam, Richard H. 04021
Pacific Ocean, northeastern margin, transverse and peripheral: Burk, Creighton A. 04028
Systems
California, Calaveras, Hayward, Silver Creek faults, gravity, magnetic data: Robbins, Stephen L. 04032
California, San Andreas, active, inactive areas, tectonic environments: Allen, Clarence R. 04041
California, San Andreas, geologic problems, conference: Stanford Univ. School Earth Sci. 03956

Faults
Systems
California, San Andreas, large-scale displacements, pre-Cretaceous rocks: Silver, Leon T. 04018
California, San Andreas, magnetic and gravity surveys: Hanna, William F. 04031
California, San Andreas, movement, recent changes: Hofmann, Renner B. 04046
California, San Andreas, Peninsular Ranges, displacements, age: Sharp, Robert V. 04023
California, San Andreas, recent strain, from triangulation surveys: Burford, Robert O. 04045
California, San Andreas, Transverse Ranges, movement: Dibblee, Thomas W., Jr. 04017
California, San Andreas, urban development of zone: Cluff, Lloyd S. 04051
Mexico, Baja California, northern, Gulf of California origin: Gastil, R. Gordon. 04020
United States, central: Heyl, Allen V. 04238

Florida
Geomorphology
Florida Keys, origin: Hoffmeister, J. E. 04292
Hydrogeology
Central and southern, resources, improvement plans: U.S. Army Corps of Engineers. 04178
Floridan aquifer, uranium disequilibrium, application: Osmond, J. K. 04077
Paleontology
Anthozoa, Pleistocene, Key Largo Limestone, Florida Keys: Hoffmeister, J. E. 04292
Cirripedia, Miocene, barnacle, type specimen questioned: Ross, Arnold. 04199
Mammalia, Tertiary, northern, paleogeography: Olsen, S. J. 04006
Stratigraphy
Pleistocene, Key Largo and Miami Limestones, Florida Keys: Hoffmeister, J. E. 04292

Fluid inclusions
Composition
Isotopic, salinity, British Columbia: Ohmoto, Hiroshi. 04153
Mexico, Zacatecas, Providencia: Rye, Robert O. 04116
Ore-forming fluids: White, Donald E. 04224
Significance: Roedder, Edwin. 04230
Fluorite
New Mexico, Hansonburg district: Roedder, Edwin. 04223
Sphalerite
Northwest Territories, Pine Point: Roedder, Edwin. 04231

Fluorspar
Mississippi Valley
Geochemistry, trace elements: Hall, Wayne E. 04122
Ore deposits, general
United States, central: Heyl, Allen V. 04238

Folds
Anticlinal
Oklahoma, Red Oak–Norris gas field: Six, David A. 04303
Anticlinoria
North Carolina, Piedmont, eastern: Parker, John M., 3d. 04101
General
Alaska, Lake Peters area, history: Reed, Bruce L. 04488
Geometry
Alberta, Nordegg area, Brazeau Range anticline: Cruden, D. M. 04064
Major
British Columbia, Dogtooth Range: Wind, G. 04090
New York, Ohio quadrangle: Nelson, Arthur E. 04003
Synclinal
Michigan, Marquette–Sands quadrangles: Gair, Jacob E. 04113
Foliation
Gneiss
New York, Ohio quadrangle: Nelson, Arthur E. 04003
Metamorphic rocks
Layering oblique to bedding: Talbot, J. L. 04435
North Carolina, Piedmont, eastern: Parker, John M., 3d. 04101
Patterns
Michigan, Marquette–Sands quadrangles: Gair, Jacob E. 04113
Foraminifera
Carboniferous
Alberta, Etherington Formation, correlation: Mamet, Bernard L. 04097
British Columbia, Connor Lakes area, correlation: Mamet, B. L. 04061
Eggerella advena
Quaternary, Gulf of Saint Lawrence, ecology: Vilks, G. 04403
Globotruncana rosetta
Cretaceous, Texas, Taylor Marl, lectotype: Esker, George C., 3d. 04405
Orbitolinidae
Eocene, Caribbean region, taxonomy, nomenclature: Butterlin, Jacques. 04324
Pseudoguembelina kempensis, n.sp.
Cretaceous, Texas, Kemp Clay, possible index: Esker, George C., 3d. 04406
Quaternary
California, Tomales Bay, benthonic, ecology: Maurer, Don. 04407
Gulf of Panama, Holocene sediments, fauna, depth effect: Golik, Abraham. 04429
Gulf of Saint Lawrence, Magdalen Shallows, ecology: Vilks, G. 04403
Silurian
Indiana, northern, arenaceous, descriptions, zonation: Mound, Michael C. 04550
Taxonomy
Orbitolinidae, revision, key to genera: Butterlin, Jacques. 04324
Foraminifera
Tertiary
Nova Scotia, continental margin, assemblages, correlation: Bartlett, Grant A. 04404
Fractures
Joints
Michigan, Marquette–Sands quadrangles: Gair, Jacob E. 04113
Mineral deposits
Replacement, susceptibility: McDougall, David J. 04121
Patterns
Montana, Little Rocky Mountains: Cotera, Augustus S., Jr. 04396
Gas, natural
Alabama
Fields and possibilities: Joiner, Thomas J. 04264
Production, 1965–66: White, H. Gene. 04301
California
Brea–Olinda field, occurrence: Gaede, Verne F. 04418
Rio Vista field, occurrence: Burroughs, Ernest. 04419
Colorado
Greenwood field, occurrence, reserves: Wingerter, H. R. 04464
Geochemistry
Helium content, bibliography: Lipper, Harold W. 04104
Kansas
Greenwood field, occurrence, reserves: Wingerter, H. R. 04464
Kentucky
Majestic, Hurley, Wharncliffe quadrangles: Outerbridge, William F. 04412
Oklahoma
Greenwood field, occurrence, reserves: Wingerter, H. R. 04464
Red Oak–Norris field, occurrence: Six, David A. 04303
Ontario
Southwestern, occurrence, production: Sanford, B. V. 04463
Texas
South–central, occurrence: Rives, John S. 04317
United States
Analyses, helium: Moore, B. J. 04106
West Virginia
Newburg Sand, exploration, occurrence: Patchen, Douglas G. 04158
Gastropoda
Cretaceous–Pleistocene
California, San Diego County, guide: Moore, Ellen J. 04354
General
Textbooks
Soil mechanics and engineering: Scott, Ronald F. 04344
Study aid, tests: Pearl, Richard M. 04351
Vegetation and soils: Eyre, S. R. 04129

Geochemical prospecting
Molybdenum
Field kit, analysis: Barakso, John. 04118
Field kit, analysis: Lapointe, Guy. 04241
Petroleum
Methods, precision: Law, Charles. 04322
Polymetallic ores
Mexico, San Luis Potosi, ore guides: Gomez, Manuel. 04115
Practice
Review, 1967: Cavender, Wayne S. 04375
Soils
A-horizon: Lapointe, Guy. 04241
Trace elements, A horizon: Boyle, R. W. 04232
Utah, Park City district: Garrett, Robert G. 04233
Stream sediments
Copper: Dahlberg, Eric C. 04236
Geochemical surveys
Alaska
Slana area, gold, base metals: Richter, Donald H. 04058
Colorado
Rabbit Ears Range, Poison Ridge volcanic center: Kinney, Douglas M. 03994
Nevada
Sheep Creek Range, western, metals: Gott, Garland B. 03996
Virginia City area, Comstock Lode district, metals: Whitebread, Donald H. 03995
Pennsylvania
South Mountain, stream sediments, copper: Dahlberg, Eric C. 04236
Geochemistry
Abundance of elements
Crust, chondrites, early solar system: Anders, Edward. 04345
Shales, boron, Colorado: Cody, Robert Dow. 04532
Applications
Mineral deposits: Kalliokoski, J. 04242
Clay organic complexes
Cation–dipole interactions: Bissada, Kadry Kaddis. 04530
Diamonds
Genesis: Dawson, J. B. 04228
Genesis: Kennedy, George C. 04229
Exchange capacity
Aluminum, soils, drying effects: Westfall, Dwayne Gene. 04448
Estuarine sediments and water, zinc, technique: Duke, Thomas W. 04496
Kimberlite
Review: Dawson, J. B. 04228
Niobium
Abundance, occurrence, summary: Parker, Raymond L. 04103
Processes
Biologic, metals: Boyle, R. W. 04234
Ion exchange, clay organic complexes: Bissada, Kadry Kaddis. 04530
Isotope fractionation, Ca–C–H–O systems: Bottinga, Yan. 04545
Supersaturation: Roedder, Edwin. 04230
Geochemistry
Shale
Ion exchange, environmental indicator: Williams, H. H. 04089
Soils
Manganese reactions, organic material: Rosell, Ramon Antonio. 04447
Solubility
Gold: Helgeson, Harold C. 04125
Iron oxides and sulfides, KCl solution: Raymahashay, Bikash C. 04076
Tantalum
Abundance, occurrence, summary: Parker, Raymond L. 04103
Volcanic gases
Isotope fractionation, Hawaii: Moore, Larry Joe. 04453
Geochronology
Growth layers
Druse minerals: Roedder, Edwin. 04230
Lichen
Colorado, Front Range, Holocene glacial history: Benedict, James B., Jr. 04529
Radiation damage
Electron spin resonance, cf. thermoluminescence, techniques: Zeller, Edward J. 03969
Thermoluminescence
Lava flows, historic, evaluation: Aitken, M. J. 03971
Limestones, 600°K glow peaks, growth curves in calcite: Medlin, W. L. 03973
Pleistocene–Pliocene dating tool, combination with radiation dosimetry: Johnson, Noye M. 03949
Pottery, clay mineral changes upon firing: Siegel, Frederic R. 03954
Technique, new: Zeller, Edward J. 03970
Technique, theory, guide lines for use: Townsend, P. D. 03984
Time scales
Organic evolution as base, development history: Berry, William B. N. 04320
Geologic thermometry
Copper ore
Haiti, Meme mine: Kesler, Stephen E. 04188
Fluid inclusions
Northwest Territories, Pine Point: Roedder, Edwin. 04231
Gold–quartz veins
Applications: Helgeson, Harold C. 04125
Iron–titanium oxides
Quebec, LaBlache Lake deposit: Anderson, A. T. 04432
Methods
Fluid inclusions, British Columbia: Ohmoto, Hiroshi. 04153
Mineral stabilities, sulfides: Desborough, George A. 04124
Zinc ores
Canada, western: Evans, T. L. 04222
Geological exploration
Subsurface
Borehole cameras: Lundgren, Raymond. 04319

Geomorphology
Catalogs
Photographs, aerial, Canada, landforms: Bostock, H. S. 04069
Environment
Ocean, Atlantic, continental rise, anti-dunes: Fox, P. J. 04492
Fluvial features
Alluvial fans, steady-state relations, arid-region: Hooke, Roger LeB. 04442
Erosion, plant cover effect through geologic time: Schumm, S. A. 04283
Rivers, dynamics and morphology: Morisawa, Marie. 04175
Stream channels, offsets by San Andreas fault, California: Wallace, Robert E. 03952
Glacial features
General, Arizona, San Francisco Peaks: Updike, Randall G. 04391
Marine features
Lagoon, barrier islands, Virginia: Newman, Walter S. 04551
Submarine fan-valley, off California, La Jolla: Shepard, Francis P. 04552
Terraces, Cape Cod to Cape Hatteras, Tertiary: Richards, Horace G. 04010
Terraces, United States, southeastern, Cenozoic: Alt, David. 04014
Topography, Atlantic Ocean, North American Basin: Pratt, Richard M. 04519
Mass movements
Earthquake-induced, Alaska, Anchorage area: Kerr, Paul F. 04194
Landslides, mechanism, Blackhawk slide, California: Shreve, Ronald L. 04299
Practice
Scope of science, relation to geography: Ritchot, Gilles. 04311
Quantitative geomorphology
Shore erosion, scales: Schwartz, Maurice L. 04430
Shore features
Erosion, scales, Bruun effect: Schwartz, Maurice L. 04430
Spits, experimental studies, spit-platform concept: Meistrell, F. J. 04066
Solution features
Caves, geometry, changing, solution processes: Lange, Arthur L. 04353
Geophysical methods
Application
Engineering geology, use and abuse: Fritz, Axel M. 04152
Instruments
Thermal probes, polar ice sheets: Aamot, Haldor W. C. 04156
Geophysical surveys
Continental margin
World, summary: Worzel, J. Lamar. 04559
Geophysics
Observations
Natural disasters, prediction, current status: Landsberg, Helmut E. 04501
Georgia
Absolute age
Pleistocene shoreline deposits: Hoyt, J. H. 03977
Paleontology
Echinoidea, Eocene, Lake City Formation, new fauna: Kier, Porter M. 04127
Stratigraphy
Pleistocene, shoreline deposits, absolute age, correlation: Hoyt, J. H. 03977
Geosynclines
Cordilleran
Genesis, tectonics: Crosby, Gary W. 04512
Metallogenesis
Review: Smirnov, V. I. 04219
Geothermal energy
Sources
General: Whiting, Robert L. 04263
United States
Potential sources: Whiting, Robert L. 04263
Glaciation
Causes
Air-ocean-icecap interactions, mathematical model: Eriksson, Erik. 04164
Astronomical theory, summer insolation variations: Broecker, Wallace S. 04172
Astronomical theory, thermal Rossby number variations: Kutzbach, John E. 04171
Epeirogeny, orogeny, volcanic dust: Damon, Paul E. 04167
Ice-free Arctic Ocean: Donn, William L. 04166
Increasing altitudes of continents, Cenozoic: Hamilton, Warren. 04170
Meteorological-isostatic model for wide continents: Tanner, William F. 04169
Ocean surface salinity changes, cyclic, theory: Weyl, Peter K. 04162
Polar wandering, continental drift, Quaternary: Cox, Allan. 04168
Solar activity theory, C-14 in atmosphere: Damon, Paul E. 04140
Solar activity theory, C-14 in atmosphere: Suess, Hans E. 04173
Theories, symposium: Mitchell, J. Murray 04161
Theories, validity, quantitative evidence: Mitchell, J. Murray, Jr. 04141
Continental
California, Sierra Nevada, three-million year old icecap: Curry, Robert R. 04246
Correlation
Pleistocene, principles: Ray, L. L. 03990
Deglaciation
Bedrock exposure, solar radiation, effect on thermoluminescence: Zeller, Anke N. 04011
Ice movements
Advances, Alberta, Banff area: Rutter, N. W. 04091
Mineral deposits, genesis
Lead, zinc, Mississippi Valley: McGinnis, L. D. 04220

Glaciers
Arctic Ocean
Pack ice, effect on air temperature and glaciation: Fletcher, J. O. 04165
Colorado
Front Range, Holocene history, lichen growth rates: Benedict, James B., Jr. 04529
Greenland
Icecap, thickness, radar method: Walker, J. W. 04284
Ice
Physical properties, measurement, thermal probes, description: Aamot, Haldor W. C. 04156
Physical properties, velocity anisotropy, petrofabric relations, Greenland: Bennett, Hugh Frederick. 04544
Thermoluminescence, relation to stress and flow history: Ronca, L. B. 03967
Gold
Abundance
Meteorites, Earth's crust: Jones, Robert S. 04502
Alaska
Slana area, geochemical prospecting: Richter, Donald H. 04058
Analysis
Mercurous chloride: Jenne, E. A. 04225
Neutron activation with fire assay separation: Rowe, J. J. 03997
California
Wilbur Springs, genesis: Joralemon, Peter. 04240
Geochemistry
Hydrothermal transport: Helgeson, Harold C. 04125
Mexico
Fresnillo, exploration: Villasenor, Luis. 04133
Tayoltita, occurrence: Randall, John A. 04197
New Mexico
Red River district, occurrence: Clark, K. F. 04226
Properties
Fineness, reflectometric determination: Eales, Hugh V. 04120
Gravel
California
Urban areas, excavation, control: Young, Eleanor. 04247
Colorado
Corral Bluffs quadrangle, occurrence: Soister, Paul E. 04411
Kentucky
Hardin quadrangle, occurrence: Scott, Glenn R. 04159
Oak Level quadrangle, occurrence: Olive, Wilds W. 04204
Gravity surveys
California
San Andreas fault, central, reconnaissance: Hanna, William F. 04031
San Jose area, Calaveras, Hayward, Silver Creek faults: Robbins, Stephen L. 04032
Gravity surveys
Kentucky
Jeptha Knob, meteorite crater: Seeger, C. Ronald. 04500
Montana
Deer Lodge Valley, maps: Cremer, E. A., 3d. 04467
Lewis and Clark Range, southeastern: Mudge, Melville R. 04110
Nevada
Sheep Creek Range, western: Gott, Garland B. 03996
Great Lakes region
Geophysical surveys
Lake Superior, acoustic experiment, wave velocity: Browning, David G. 04468
Paleoclimatology
Quaternary, air circulation patterns, postglacial: Stuiver, Minze. 04062
Greenland
Geophysical surveys
North-central, icecap, radar sounding: Walker, J. W. 04284
Glacial geology
North-central, icecap thickness, radar measurements: Walker, J. W. 04284
Sea-level changes, glacioeustatic, Plio-Pleistocene: Mercer, John H. 04057
Stratigraphy
Precambrian: Berthelsen, A. 04466
Structural geology
Precambrian rocks: Berthelsen, A. 04466
Ground water
El Salvador
Development, Rio Grande de San Miguel basin: Patchick, Paul F. 04313
Florida
Geochemistry, isotope dilution, uranium disequilibrium: Osmond, J. K. 04077
Hawaii
Levels, 1961–65: U.S. Geological Survey. 04470
Idaho
Resources, problems, Pullman–Moscow basin: Crosby, James W., 3d. 04325
Illinois
Contamination, northeastern, geophysical surveys: Cartwright, Keros. 04269
Kentucky
Resources, Arlington, Wickliffe SW quadrangles: Davis, R. W. 04334
Resources, Hardin quadrangle: Scott, Glenn R. 04159
Minnesota
Resources, quality, west-central, Chippewa River watershed: Cotter, R. D. 04378
Resources, west-central, Mustinka–Bois de Sioux Rivers watershed: Maclay, R. W. 04424
Mississippi Valley
Composition, embayment area: Jeffery, H. G. 04518
Movement, Pleistocene: McGinnis, L. D. 04220

Ground water
Mississippi Valley
Resources, embayment area: Boswell, E. H. 04517
Montana
Resources, Deer Lodge Valley: Konizeski, R. L. 04376
Nevada
Flow systems, types, Great Basin: Maxey, George B. 04268
Resources, Clayton Valley–Stonewall Flat area: Rush, F. Eugene. 04312
North Carolina
Resources, Chowan County: Lloyd, O. B., Jr. 04383
Northwest Territories
Paleomovements, Pine Point: Roedder, Edwin. 04231
Oklahoma
Levels, Great Salt Plains, relation to temperature and humidity: Davis, Johnnie L. 04340
Oregon
Resources, data, Santiam River basin, lower: Helm, D. C. 04321
South Carolina
Regimen, Berkeley and Charleston Counties, impact of canals: Siple, George E. 04000
Texas
Resources, Polk County: Tarver, George R. 04216
Resources, San Jacinto County: Sandeen, W. M. 04217
United States
Levels, 1961–65, southwestern: U.S. Geological Survey. 04470
Utah
Resources, Sevier Desert: Mower, R. W. 04469
Washington
Resources, problems, Pullman–Moscow basin: Crosby, James W., 3d. 04325
Guatemala
Maps, geologic
Cuilco area: Bradford, Douglas E. 04333
Gulf Coastal Plain
Paleontology
Pelecypoda, Tertiary, alticostate venericards, evolution: Heaslip, William Graham. 04377
Gulf of California
Structural geology
Genesis, relation to San Andreas and Baja California faults: Gastil, R. Gordon. 04020
Gulf of Mexico
Geophysical surveys
Sigsbee Deep, Bay of Campeche, seismic, salt diapirs: Worzel, J. Lamar. 04465
Mineralogy
Clay minerals, cores: Scafe, Donald William. 04547
Structural geology
Sigsbee Deep to Bay of Campeche, salt diapirs: Worzel, J. Lamar. 04465
Texas margin, upper mantle, seismic-wave data: Shurbet, D. H. 04254
Gulf of Saint Lawrence
Marine geology
Ecology, Magdalen Shallows, foraminifera: Vilks, G. 04403
Gymnosperms
Alethopteris ambigua
Pennsylvanian, Missouri, Henry County, xeromorphy: Cridland, Arthur A. 04278
Cycadeoidales
Mesozoic, evolution, cone origin, hypotheses: Delevoryas, T. 04256
Williamsonia nizhonia, n.sp.
Triassic, New Mexico, Chinle Formation: Ash, Sidney R. 04255
Haiti
Economic geology
Copper, Meme mine: Kesler, Stephen E. 04188
Geochemistry
Meme mine, copper deposit: Kesler, Stephen E. 04188
Hawaii
Absolute age
Lava flows, 1750–1907, thermoluminescence method: Aitken, M. J. 03971
Earthquakes
Seismicity: U.S. Bureau of Reclamation. 04180
Geochemistry
Kilauea Volcano, gases, compositional trends: Finlayson, James Bruce. 04452
Volcanic gases, isotope fractionation: Moore, Larry Joe. 04453
Geophysical surveys
Hawaiian arch, seismic: Normark, William R. 04286
Hydrogeology
Ground-water levels, 1961–65: U.S. Geological Survey. 04470
Mineralogy
Illite, montmorillonite, authigenic marine: Moberly, Ralph, Jr. 04282
Petrology
Basalt, sulfide phases: Desborough, George A. 04124
Heat flow
California
Sierra Nevada, geothermal model: Lachenbruch, Arthur H. 04287
Conductivity
Shield areas, effect of cracks: Simmons, Gene. 04073
Geothermal gradient
Superficial measurement, topographic disturbance, estimation: Lachenbruch, Arthur H. 04095
Heat sources
Northwest Territories, Pine Point: Roedder, Edwin. 04231
Instruments
Thermal probes, polar ice sheets: Aamot, Haldor W. C. 04156

Heat flow
United States
Plutonic rocks, continental heat flow provinces: Roy, Robert F. 04526
Helium
Bibliography
Occurrence, minerals, natural gas, meteorites: Lipper, Harold W. 04104
Geochemistry
Natural gas, United States: Moore, B. J. 04106
History
Paleobotany
Arizona: Romans, Robert C. 04384
Hydrogen
Isotopes
Fractionation, graphite–calcite–methane–carbon dioxide: Bottinga, Yan. 04545
Ratios, British Columbia: Ohmoto, Hiroshi. 04153
Hydrogeology
Aquifer properties
Mississippi Valley, embayment, alluvial: Boswell, E. H. 04517
Exploration methods
Dowsing, history, theory: Barrett, William. 04174
Geochemistry
Thermal, mineral waters: White, Donald E. 04224
Ground-water movement
Pleistocene, Mississippi Valley: McGinnis, L. D. 04220
Resource development
Florida, central and southern, improvement plans: U.S. Army Corps of Engineers. 04178
Seminar papers, management: Campbell, Thomas H. 04338
Hydrothermal alteration
Alabama
Mafic–ultramafic belt, Tallapoosa and Chambers Counties: Neathery, Thornton L. 04323
Albitization
Mexico, Tayoltita: Randall, John A. 04197
Collapse breccia
Definition: Bryner, Leonid. 04119
Colorado
Contact zone, Rabbit Ears Range, geochemical anomalies: Kinney, Douglas M. 03994
Potassic
Porphyry copper: Guilbert, John M. 04139
Process
Utah, Kane Creek, uranium veins: Davidson, Donald M., Jr. 04293
Propylitic
New Mexico: Clark, K. F. 04226
Skarn
Geochemistry: Titley, Spencer R. 04155
Geochemistry, isotopes: Chrismas, L. 04138
Hydrothermal alteration
Skarn
Nevada, Nye County: Hewett, D. F. 04221
Utah
Bingham, absolute age: Moore, W. J. 04239
Zoning
Arizona, San Manuel district: Lowell, J. David. 04123
Idaho
Areal geology
Alder Creek mining district: Nelson, W. H. 04109
Hydrogeology
Pullman–Moscow basin, ground-water resources, problems: Crosby, James W., 3d. 04325
Maps, geologic
Alder Creek mining district: Nelson, W. H. 04109
Structural geology
Southeastern, tectonics: Crosby, Gary W. 04512
Igneous rocks
Alkalic
Genesis, mantle convection: Keith, M. L. 04117
Stocks, zoning: Giles, David L. 04154
Alkali-gabbroic
Petrology, Greenland, dikes: Bhattacharji, Somdev. 04437
Aplite
Petrology, hydrothermal: Randall, John A. 04197
Basalt
Composition, rare earth abundances: Frey, Fred A. 04359
General description, Cenozoic sheet, U.S., northwestern: Wheeler, H. E. 04481
Geochemistry, sulfide phases: Desborough, George A. 04124
Petrology, Mid-Atlantic Ridge: Melson, W. G. 04367
Physical properties, magnetic, Arizona, Flagstaff area: Strangway, David W. 04285
Physical properties, reversed magnetization vs. oxidation state: Wright, J. B. 04290
Pillow structure, North Carolina, Orange County: Wilson, William F. 04102
Basaltic
General description, Triassic plugs, extrusive rocks, Massachusetts, Mt. Tom Range: Foose, Richard M. 04280
Composition
Variations, X-ray fluorescence: Laidley, Richard A. 04273
Diabase
Composition, rare earth abundances: Frey, Fred A. 04359
Physical properties, strength, water effect on compressive: Simpson, Dale R. 04304
Gabbro
Composition, rare earth abundances: Frey, Fred A. 04359

Igneous rocks
General
Absolute age, Arizona, Santa Rita Mountains: Drewes, Harald. 04108
General description, North Carolina, Piedmont, eastern: Parker, John M., 3d. 04101
Geochemistry, general description, Idaho, Alder Creek district: Nelson, W. H. 04109
Petrology, Michigan, Marquette-Sands quadrangles: Gair, Jacob E. 04113
Petrology, New York, Ohio quadrangle: Nelson, Arthur E. 04003
Granite
Physical properties, in place, cf. laboratory measurement: Simmons, Gene. 04073
Granitic
Differentiation, Utah: Moore, W. J. 04239
Melting, experimental, Sierra Nevada batholith, California: Piwinskii, A. J. 04433
Petrology, Sherman Granite, Colorado-Wyoming: Eggler, D. H. 04295
Granitization
Wyoming, pegmatite: Proctor, Paul Dean. 04126
Kimberlite
Petrology: Kennedy, George C. 04229
Review: Dawson, J. B. 04228
Melting
Experimental studies, Sierra Nevada batholith, California: Piwinskii, A. J. 04433
Pegmatite
General description, Northwest Territories, Yellowknife-Beaulieu area: Kretz, R. 04382
General description, Wyoming: Proctor, Paul Dean. 04126
Peridotite
Melting, high pressure experiment: Kushiro, Ikuo. 04485
Petrology
Mineral deposits, genesis: Kalliokoski, J. 04242
Physical properties
Thermoluminescence, near ore deposits: McDougall, David J. 03959
Thermoluminescence, silicates, proton excited: Nash, Douglas B. 03958
Thermoluminescence, syenite, effect of pressure: Morency, Maurice. 03966
Porphyry
Petrology, Colorado, Rabbit Ears Range: Kinney, Douglas M. 03994
Quartz monzonite
Petrology, Haiti, Meme mine: Kesler, Stephen E. 04188
Petrology, plagioclase zoning, Washington, Mt. Pilchuk: Wiebe, Robert A. 04499
Syenite
Absolute age, New Mexico, Pajarito Mtn.: Kelley, Vincent C. 04296
Volcanics
Absolute age, historic flows, thermoluminescent study: Aitken, M. J. 03971

Igneous rocks
Volcanics
Geochemistry, Arizona, San Francisco Peaks: Deal, Edmond G. 04392
Illinois
Absolute age
Northern, late Altonian glacial sequence, C 14: Kempton, J. P. 03979
Areal geology
Hennepin region: McComas, Murray R. 04318
Engineering geology
Land use, Hennepin region: McComas, Murray R. 04318
Sanitary landfills, ground-water alteration, test surveys: Cartwright, Keros. 04269
Waste disposal, by wells, criteria: Bergstrom, Robert E. 04267
Geochemistry
Cave-in-Rock district, sulfide minerals, trace element zonation: Hughes, Travis Hubert. 04538
Geophysical surveys
Northeastern, near sanitary landfills, electrical: Cartwright, Keros. 04269
Paleontology
Mammalia, Pleistocene, geographic distribution: Ray, Clayton E. 04379
Pteridophytes, Pennsylvanian, Mattoon Formation, new: Dennis, Robert L. 04495
Stratigraphy
Pleistocene, late Altonian sequence, northern: Kempton, J. P. 03979
Inclusions
Kimberlite
General: Dawson, J. B. 04228
Indiana
Economic geology
Limestone, Devonian, Silurian, resources: French, Robert R. 04483
Paleontology
Foraminifera, Silurian, arenaceous, descriptions, zonation: Mound, Michael C. 04550
Insecta
Rhyncolus kathrynae, n.sp.
Pliocene, Nevada, Fernley area, in pine branch: Sleeper, Elbert L. 04179
Intrusions
General
North Carolina, Piedmont, eastern: Parker, John M., 3d. 04101
Mechanism
Pegmatite, Wyoming: Proctor, Paul Dean. 04126
Pipes
Diamond, mechanism: Kennedy, George C. 04229
Plugs
Massachusetts, Mount Tom Range: Foose, Richard M. 04280
Structure
Plagioclase zoning, Mount Pilchuk, Washington: Wiebe, Robert A. 04499

Invertebrata
Atlas
Illustrated, selected specimens: Case, Gerard R. 04347

Iowa
Engineering geology
Highways, design, effect of peat deposits: Blattert, Robert E. 04146
Materials, properties, rock cores, evaluation: Michael, Robert D. 04145
Sedimentary petrology
Soils, aggregates, physical and chemical properties: Tabatabai, M. A. 04190

Iron
Mexico
Colima, Cerro Nahuatl, occurrence, genesis: Neilson, James M. 04132
Minnesota
Animikie basin, Precambrian, cf. Australia, South Africa: Trendall, A. F. 04294
Quebec
LaBlache Lake deposit, geochemistry, genesis: Anderson, A. T. 04432

Isostasy
Compensation
United States, southeastern, Tertiary: Tanner, William F. 04008
Processes
Flow in mantle, glacial loading: McConnell, Robert K., Jr. 04186
Wyoming
Western, overthrust belt, gravity data: Crosby, Gary W. 04512

Isotopes
Carbon
Cosmogenic, C-14 in atmosphere, variations: Suess, Hans E. 04173
Marine plankton, composition: Degens, E. T. 04440
Marine plankton, metabolic fractionation: Degens, E. T. 04439
Cesium
Clay suspensions, transport, model river system: Purushothaman, Krishnier. 04528
Copper ore
Sulfur, oxygen, carbon: Chrismas, L. 04138
Fractionation
Calcite–graphite–carbon dioxide–methane–hydrogen–water: Bottinga, Yan. 04545
Lead
Galena, Cambrian–Devonian rocks, Montana: Zartman, R. E. 04111
Lithium
Meteorites, stony, abundance: Balsiger, H. 04524
Mineral deposits
General: Smirnov, V. I. 04219
Ore-forming fluids
Ratios: White, Donald E. 04224
Ores
Hydrogen, oxygen, British Columbia: Ohmoto, Hiroshi. 04153

Isotopes
Oxygen
Iron–titanium oxides, anorthosite host, fractionation: Anderson, A. T. 04432
Marls, mollusks, Great Lakes region, postglacial: Stuiver, Minze. 04062
Phosphorites, composition, marine formations: Longinelli, A. 04525
Sulfate water system, behavior: Lloyd, R. M. 04360
Ratios
Rb:Sr: Chrismas, L. 04138
Strontium
Clay suspensions, transport, model river system: Purushothaman, Krishnier. 04528
Sulfur
Ratios, Canada, western: Evans, T. L. 04222
Tracer experiments
Sulfur, partial pressure: Giletti, B. J. 04137
Uranium
Analysis, methods, activation, natural waters: Edwards, Kenneth W. 04326
Ground water, isotope dilution approach: Osmond, J. K. 04077
Volcanic gases
Fractionation, Hawaii: Moore, Larry Joe. 04453

Jurassic
Arizona
Northern, stratigraphy and paleontology, popular account: Breed, William J. 04337
Canada
Western, stratigraphy: Carlson, C. E. 04510
Montana
Stratigraphy: Carlson, C. E. 04510
North Dakota
Stratigraphy: Carlson, C. E. 04510

Kansas
Economic geology
Natural gas, Greenwood field: Wingerter, H. R. 04464
Engineering geology
Highways, applications in construction, review: Burgat, Virgil A. 04143

Kentucky
Economic geology
Coal, natural gas, Majestic, Hurley, Wharncliffe quadrangles: Outerbridge, William F. 04412
Gravel, clays, Hardin quadrangle: Scott, Glenn R. 04159
Gravel, clays, Oak Level quadrangle: Olive, Wilds W. 04204
Mineral resources, Bee Spring quadrangle: Gildersleeve, Benjamin. 04209
Mineral resources, Hodgenville quadrangle: Moore, Frank B. 04207
Mineral resources, Repton quadrangle: Seeland, David A. 04208
Engineering geology
Materials, properties, Paducah West and Metropolis quadrangles: Finch, Warren I. 04004

Kentucky
Geophysical surveys
Jeptha Knob, gravity, magnetic: Seeger, C. Ronald. 04500
Hydrogeology
Arlington, Wickliffe SW quadrangles, aquifers: Davis, R. W. 04334
Hardin quadrangle, ground-water resources: Scott, Glenn R. 04159
Maps, engineering geology
Paducah West quadrangle, Metropolis quadrangle, part: Finch, Warren I. 04004
Maps, geologic
Bee Spring quadrangle: Gildersleeve, Benjamin. 04209
Hardin quadrangle: Scott, Glenn R. 04159
Hodgenville quadrangle: Moore, Frank B. 04207
Majestic, Hurley, Wharncliffe quadrangles, parts: Outerbridge, William F. 04412
Oak Level quadrangle: Olive, Wilds W. 04204
Pulaski County, pre-Chattanooga: Helton, Walter L. 04182
Repton quadrangle: Seeland, David A. 04208
Maps, ground water
Arlington, Wickliffe SW quadrangles: Davis, R. W. 04334
Maps, isopach
Pulaski County, Crab Orchard Shale: Helton, Walter L. 04182
Maps, structure
Pulaski County, base of Chattanooga Shale: Helton, Walter L. 04182
Stratigraphy
Carboniferous, Quaternary, Bee Spring quadrangle, section: Gildersleeve, Benjamin. 04209
Carboniferous, Quaternary, Repton quadrangle, section: Seeland, David A. 04208
Cretaceous-Quaternary, Hardin quadrangle, section: Scott, Glenn R. 04159
Cretaceous-Quaternary, Oak Level quadrangle, section: Olive, Wilds W. 04204
Mississippian, Quaternary, Hodgenville quadrangle, section: Moore, Frank B. 04207
Pennsylvanian, Quaternary, Majestic, Hurley, Wharncliffe quadrangles, section: Outerbridge, William F. 04412
Silurian-Devonian, Pulaski County: Helton, Walter L. 04182
Structural geology
Jeptha Knob, meteorite impact origin: Seeger, C. Ronald. 04500

Lakes
Geochemistry
California, High Sierras, trace-element contents: Bradford, G. R. 04472
Sediments, Fe-reducing environment, Eh and thermodynamic equilibrium: Doyle, Roger Whitney Stevens. 04535
Limnology
Wisconsin, Madison area, Lake Mendota: Nriagu, Jerome O. 04473

Lakes
Wisconsin
Lake Mendota, nitrogen cycle: Brezonik, Patrick Lee. 04451

Lakes, extinct
Arizona
Winona area, evidence: Batchelder, George L. 04388
California
Searles Lake, Quaternary sedimentation, climate: Smith, G. I. 03975
Texas
Lake Lomax, western, sedimentation history: Frye, J. C. 03978

Lanthanum
Abundance
Brenham meteorite: Masuda, Akimasa. 04520

Lead
Analysis
Atomic absorption spectroscopy, water, chelation-extraction: Fishman, Marvin J. 04308
British Columbia
Bluebell mine, genesis: Ohmoto, Hiroshi. 04153
Canada
Western, occurrence: Evans, T. L. 04222
Geochemistry
Biologic concentration: Boyle, R. W. 04234
Carbonate replacement deposits: Titley, Spencer R. 04155
Isotopes
Composition, Cambrian-Devonian rocks, Montana: Zartman, R. E. 04111
Mexico
Durango, Mapimi district, occurrence: Hoffmann, Victor J. 04131
Naica, Fresnillo, exploration: Villasenor, Luis. 04133
San Luis Potosi, ore guides: Gomez, Manuel. 04115
Mississippi Valley
Genesis, glaciation as cause: McGinnis, L. D. 04220
Geochemistry, trace elements: Hall, Wayne E. 04122
New Mexico
Hansonburg district, Mex-Tex deposits: Roedder, Edwin. 04223
Northwest Territories
Pine Point, genesis: Roedder, Edwin. 04231
Ore deposits, general
United States, central: Heyl, Allen V. 04238

Limestone
Indiana
Resources, Devonian, Silurian: French, Robert R. 04483

Lineation
Gneiss
New York, Ohio quadrangle: Nelson, Arthur E. 04003

Lithium
Abundance
Meteorites, stony, isotopic: Balsiger, H. 04524

Louisiana
Sedimentary petrology
Citronelle Formation, heavy minerals: Rosen, Norman Charles. 04543

Magmas
Cooling history
Stocks, alkalic: Giles, David L. 04154
Deuteric phenomena
Ore-forming fluids, Mexico: Rye, Robert O. 04116
Differentiation
California, Sierra Nevada batholith: Piwinskii, A. J. 04433
Granitic, plagioclase zoning as key, Washington: Wiebe, Robert A. 04499
Liquid immiscibility: Desborough, George A. 04124
Mechanism, flow and dike injection: Bhattacharji, Somdev. 04437
Mineral deposits, genesis: Smirnov, V. I. 04219
Experimental studies
California, Sierra Nevada batholith, central: Piwinskii, A. J. 04433
Olivine, quartz-tholeiite types, formation from lherzolite: Kushiro, Ikuo. 04485
Genesis
Mantle convection: Keith, M. L. 04117
Sialic, melting of crustal rock, objections: Weyl, R. 04482
Temperature
Wall-rock thermoluminescence, paleothermometer: Johnson, Noye M. 03960

Magnesite
Washington
Okanogan County, northern, occurrence, composition: Fox, Kenneth F., Jr. 04112

Magnetic field, Earth
Secular variations
Core, kinematics: Booker, John Ratcliffe. 04531

Magnetic properties
Basalt
Reversed polarity, correlation with oxidation state: Wright, J. B. 04290
Coal
Proton magnetic relaxation, room-temperature, bituminous: Retcofsky, H. L. 04490
Hematite-maghemite intergrowths
Remanent magnetization, direction and intensity: Porath, H. 04369
Marine sediments
Magnetic fabric, cores, off California, La Jolla canyon and fan: Rees, Anthony I. 04425
Measurements
Arizona, Ajo porphyry copper deposit: May, Bruce Tipton. 04546

Magnetic surveys
California
San Andreas fault, central, airborne reconnaissance: Hanna, William F. 04031
San Bruno-Hollister area, San Andreas fault, piezomagnetic changes: Breiner, Sheldon. 04033
San Jose area, Calaveras, Hayward, Silver Creek faults, airborne: Robbins, Stephen L. 04032
Kentucky
Jeptha Knob, meteorite crater: Seeger, C. Ronald. 04500
Montana
Lewis and Clark Range, southeastern: Mudge, Melville R. 04110
Nevada
Sheep Creek Range, western: Gott, Garland B. 03996
New Brunswick
Miramichi Bay area, anomaly, structural interpretation: McGrath, P. H. 04402
Pacific Ocean
Northeastern, anomaly lineations: Luyendyk, Bruce P. 04368
United States
Transcontinental, airborne: Zietz, Isidore. 04262

Maine
Maps, geologic
Connecticut Lakes-Parmachenee area: Green, John Chandler. 04298
Northeastern: Pavlides, Louis. 04107
Stratigraphy
Cambrian-Devonian, Connecticut Lakes-Parmachenee area: Green, John Chandler. 04298
Ordovician-Silurian, Carys Mills Formation, northeastern: Pavlides, Louis. 04107
Structural geology
Connecticut Lakes-Parmachenee area: Green, John Chandler. 04298

Major-element analyses
Basalt
North Carolina, Orange County, pillows: Wilson, William F. 04102
Fluid inclusions
Mexico, atomic absorption, X-ray fluorescence: Rye, Robert O. 04116
Geologic samples
Spectroscopy, atomic absorption: Galle, O. Karmie. 04270
Gneiss
New York, Ohio quadrangle: Nelson, Arthur E. 04003
Ground water
Mississippi Valley, embayment, alluvial aquifers: Boswell, E. H. 04517
Mississippi Valley, embayment area: Jeffery, H. G. 04518
Oregon, Santiam River basin, lower: Helm, D. C. 04321
Texas, Polk County: Tarver, George R. 04216
Igneous rocks
Arizona, Hopi Buttes, X-ray fluorescence: Laidley, Richard A. 04273

Major-element analyses
Igneous rocks
Idaho, Alder Creek mining district: Nelson, W. H. 04109
Oregon, Newberry Crater, X-ray fluorescence: Laidley, Richard A. 04273
Utah, Bingham: Moore, W. J. 04239
Iron-titanium oxides
Quebec, LaBlache Lake, titaniferous magnetite deposit: Anderson, A. T. 04432
Limestone
Idaho, Alder Creek mining district: Nelson, W. H. 04109
Pegmatite
Wyoming: Proctor, Paul Dean. 04126
Schist
District of Columbia, chlorite-talc: Broughton, Paul L. 04098
Tuff clasts
California, Paleogene conglomerates: Woodford, A. O. 04291
Mammalia
Coendou, n.sp.
Pleistocene, California, Palm Springs Formation: White, John A. 04335
Entoptychus
Oligocene-Miocene, Oregon, John Day Formation: Rensberger, John Marshall. 04549
Erethizon
Morphology, cf. *Coendou*, mastication: White, John A. 04335
Ovibos
Illinois, Pleistocene, geographic distribution: Ray, Clayton E. 04379
Sigmodon
Quaternary, Arizona, southeastern, taxonomy: Cantwell, R. J. 04389
Symbos
Illinois, Pleistocene, geographic distribution: Ray, Clayton E. 04379
Tertiary
Florida, paleogeographic indicators: Olsen, S. J. 04006
Oregon, John Day Formation, gophers, evolution: Rensberger, John Marshall. 04549
Man, fossil
Evolution
Elementary account: Moore, Ruth. 04332
Manganese
Geochemistry
Soils, organic material, reactions: Rosell, Ramon Antonio. 04447
Mexico
Metallogenetic provinces: Wilson, Ivan F. 04148
Nevada
Nye County, occurrence: Hewett, D. F. 04221
Manitoba
Mineralogy
Winnipeg area, swelling clay soils: Quigley, Robert M. 04260
Mantle
Composition
Diamonds, genesis: Kennedy, George C. 04229
Experimental studies
Melting, temperature of beginning: Kushiro, Ikuo. 04485
Low-velocity layer
Cause, partial melting, experimental study: Spetzler, Hartmut. 04486
Physical properties
Viscosity, relaxation time spectra: McConnell, Robert K., Jr. 04186
Processes
Convection, effect of low viscosity layer: McFadden, C. P. 04491
Convection, mobile fluids, generation: Keith, M. L. 04117
Structure
Texas, Gulf of Mexico margin, S-phase data: Shurbet, D. H. 04254
Marine geology
Atlantic Ocean
Mid-Atlantic Ridge, volcanism, metamorphism: Melson, W. G. 04367
Bottom features
Abyssal anti-dunes: Fox, P. J. 04492
Atlantic Ocean, Nova Scotia to Puerto Rico, topography: Pratt, Richard M. 04519
Fan-valley, California, off La Jolla: Shepard, Francis P. 04552
Guyots, Pacific Ocean, western, volcanic: Boyce, R. E. 04426
Pacific Ocean, Hawaiian arch, seismic survey: Normark, William R. 04286
Instruments
Grab sampler, for bottom sediment, water, organisms: Carey, Andrew G., Jr. 04560
Sediments
Deep-sea, Pleistocene paleotemperatures of carbonates: Eriksson, Erik. 04164
Deep-sea, Quaternary, water temperatures and salinity: Worthington, L. V. 04163
Gulf of Panama, Holocene history: Golik, Abraham. 04429
Maryland
Geochemistry
Baltimore area, schist weathering, silicate-water interaction: Bricker, Owen P. 04307
Paleontology
Palynology, Quaternary, Cranesville Swamp, profile: Cox, Donald D. 04346
Weathering
Baltimore area, schist, silicate-water interaction: Bricker, Owen P. 04307
Massachusetts
Absolute age
Cape Ann Granite, weathered samples: Bottino, Michael L. 04497
Maps, geologic
Wellfleet quadrangle: Oldale, Robert N. 04160

Massachusetts
Petrology
Mount Tom Range, basaltic plugs and extrusives: Foose, Richard M. 04280
Stratigraphy
Quaternary, Wellfleet quadrangle, section: Oldale, Robert N. 04160
Weathering
Cape Ann Granite, effects on Rb-Sr ratios: Bottino, Michael L. 04497
Mesozoic
Alaska
Lake Peters area, stratigraphy: Reed, Bruce L. 04488
Arizona
Santa Rita Mountains, new formations, absolute age: Drewes, Harald. 04108
Gymnosperms
Cycadeoidales, evolution, cone origin, hypotheses: Delevoryas, T. 04256
Palynology
Catalog: Traverse, A. 04328
Wyoming
Western, tectonics: Crosby, Gary W. 04512
Metals
Alaska
Slana area, geochemical prospecting: Richter, Donald H. 04058
Genesis
Replacement processes, lattice defects: McDougall, David J. 04121
Review: Smirnov, V. I. 04219
Geochemistry
Ore deposits, general, ore-forming fluid: White, Donald E. 04224
Mexico
Queretaro, La Negra, occurrence: Mejorada, Pedro Sanchez. 04134
Nevada
Sheep Creek Range, western, exploration: Gott, Garland B. 03996
Virginia City area, Comstock Lode district, exploration: Whitebread, Donald H. 03995
Metamorphic rocks
General
Alteration, cataclastic, Alberta, Precambrian shield: Watanabe, R. Y. 04092
Petrology, Michigan, Marquette Sands quadrangles: Gair, Jacob E. 04113
Gneiss
Petrology, structural features, New York, Ohio quadrangle: Nelson, Arthur E. 04003
Low-grade
Structural features, layering oblique to bedding: Talbot, J. L. 04435
Mineral facies
North Carolina, Piedmont, eastern: Parker, John M., 3d. 04101
Quartzite
Fabric, cross girdle orientations, c axis, genesis: Sylvester, A. G. 04434
Schist
Genesis, California, southern, deep burial by thrust sheets: Ehlig, Perry L. 04024
Metamorphic rocks
Schist
Mineral composition, District of Columbia: Broughton, Paul L. 04098
Metamorphism
Contact
Colorado, effect on zircon ages: Davis, G. L. 04522
Skarn deposits: Titley, Spencer R. 04155
Skarn, geochemistry: Burt, D. M. 04136
Skarn, Mexico, Colima, Cerro Nahuatl: Neilson, James M. 04132
Skarn, P-T conditions, Haiti: Kesler, Stephen E. 04188
Migration of elements
Metamorphic differentiation, low-grade rocks: Talbot, J. L. 04435
Regional
Alabama, Tallapoosa and Chambers Counties, mafic-ultramafic belt: Neathery, Thornton L. 04323
Connecticut, Long Hill and Bridgeport quadrangles: Crowley, William Patrick. 04302
Retrograde
Quebec, Mont Tremblant Park, granulite to amphibolite facies: Katz, Michael B. 04444
Meteor craters
Kentucky
Jeptha Knob, origin: Seeger, C. Ronald. 04500
Texas
Sierra Madera, central uplift, deformation pattern: Wilshire, H. G. 04305
Meteorites
Age
Hypersthene chondrites, Rb-Sr: Gopalan, K. 04184
Brenham
Lanthanide abundances: Masuda, Akimasa. 04520
Chondrites
Enstatite, mineralogical, chemical relations: Keil, Klaus. 04196
Composition
Chemical processes in early solar system: Anders, Edward. 04345
Gold: Jones, Robert S. 04502
Helium, bibliography: Lipper, Harold W. 04104
Lithium, distribution, isotopic abundance in stony: Balsiger, H. 04524
General
Identification, ages: Karner, Frank R. 04314
Genesis
Chemical processes in early solar system: Anders, Edward. 04345
North Dakota
Finds, recognition: Karner, Frank R. 04314
Norton County
Lithium concentration: Balsiger, H. 04524

Mexico
Areal geology
Baja California, southern tip, continental margin: Normark, William R. 04297
Economic geology
Iron, Colima, Cerro Nahuatl: Neilson, James M. 04132
Metallogenetic provinces: Wilson, Ivan F. 04148
Metals, Durango, Mapimi district: Hoffmann, Victor J. 04131
Metals, Naica, Fresnillo: Villasenor, Luis. 04133
Metals, Tayoltita, exploration: Randall, John A. 04197
Queretaro, La Negra: Mejorada, Pedro Sanchez. 04134
Sulfur, general: Salas, Guillermo P. 04147
Geochemistry
San Luis Potosi, geochemical prospecting: Gomez, Manuel. 04115
Skarn, oxygen buffer: Burt, D. M. 04136
Zacatecas, Providencia, fluid inclusions: Rye, Robert O. 04116
Zacatecas, Providencia, ore deposits, fluid inclusions: White, Donald E. 04224
Geophysical surveys
Baja California, continental margin, seismic: Normark, William R. 04297
Maps, geologic
Baja California, southern tip: Normark, William R. 04297
Paleontology
Mollusca, diatoms, Cenozoic, Baja California: Hertlein, Leo G. 04300
Stratigraphy
Precambrian–Mesozoic, Sonora, old massif and Mesozoic sequence, correlation: King, Philip B. 04022
Structural geology
Baja California, northern, fault systems, Gulf of California origin: Gastil, R. Gordon. 04020
Sonora, northwest-trending faults, possible San Andreas extension: Merriam, Richard H. 04021
Michigan
Economic geology
Copper, Nonesuch Shale, genesis: White, Donald E. 04224
Maps, geologic
Marquette and Sands quadrangles: Gair, Jacob E. 04113
Paleontology
Trilobita, Devonian, Alpena Limestone, new species: Stumm, Erwin C. 04201
Petrology
Marquette–Sands quadrangles, Precambrian rocks: Gair, Jacob E. 04113
Structural geology
Marquette–Sands quadrangles: Gair, Jacob E. 04113
Microwave methods
General
Spectral tables: Cord, Marian S. 04357
Mineragraphy
Reflectivity
Gold, fineness, determination: Eales, Hugh V. 04120
Textures
Colloform, interpretation: Roedder, Edwin. 04230
Copper ore, Haiti: Kesler, Stephen E. 04188
Silver ores, Ontario: Petruk, William. 04227
Sulfides, basalt, Hawaii: Desborough, George A. 04124
Mineral collecting
Guides
Vermont: Grant, Raymond W. 04339
Mineral data
Albite
Phase equilibria data: Newton, M. S. 04498
Analcite
Phase equilibria data: Newton, M. S. 04498
Anhydrite
Physical properties, thermoluminescence, traps and emission centers: Medlin, W. L. 03965
Apatite
Carbonate substitution: LeGeros, Racquel Zapanta. 04449
Composition, fluctuations, X-ray diffraction analysis monitoring: Skinner, H. C. W. 04272
Calcite
Geochemistry, 15-kb phase transition: Peselnick, Louis. 04371
Physical properties, thermoluminescence, growth curves: Medlin, W. L. 03973
Physical properties, thermoluminescence, ultraviolet light effect: Vaz, J. E. 03974
Carbonates
Physical properties, thermoluminescence, traps and emission centers: Medlin, W. L. 03965
Diamond
Synthetic: Dawson, J. B. 04228
Ferroselite
Synthetic: Warren, C. Gerald. 04235
Galena
Genesis, nuclear explosion, GNOME: Gard, Leonard M., Jr. 04059
Trace elements, Mississippi Valley: Hall, Wayne E. 04122
Gold
Fineness, determination: Eales, Hugh V. 04120
Gratonite
Geochemistry, low-temperature dimorph of jordanite: Roland, George W. 04428
Hematite
Properties, magnetic, intergrowths, with maghemite: Porath, H. 04369
Iron-titanium oxides
Quebec, LaBlache Lake, oxidation-exsolution: Anderson, A. T. 04432
Jadeite
Phase equilibria data: Newton, M. S. 04498

Mineral data
Jordanite
Stability, composition: Roland, George W. 04428
Kimberlite minerals
New occurrences: Dawson, J. B. 04228
Laurionite
Genesis, nuclear explosion, GNOME: Gard, Leonard M., Jr. 04059
Maghemite
Properties, magnetic, intergrowths, with hematite: Porath, H. 04369
Mica
Synthesis, low temperature, ammonium phase: Levinson, A. A. 04521
Nepheline
Phase equilibria data: Newton, M. S. 04498
Niobium minerals
Glossary, classification by chemical type: Parker, Raymond L. 04103
Quartz
Physical properties, thermoluminescence, traps and emission centers: Medlin, W. L. 03965
Silicates
Crystal chemistry, structon theory: Huggins, Maurice L. 04348
Properties, adhesion, cleaved in ultrahigh vacuum: Ryan, J. A. 04487
Sphalerite
Textures, colloform, interpretation: Roedder, Edwin. 04230
Trace elements, Mississippi Valley: Hall, Wayne E. 04122
Sulfides
Compostiion, basalt magma, Hawaii Desborough, George A. 04124
Trace elements, zonation, Illinois, Cave-in-Rock district: Hughes, Travis Hubert. 04538
Tantalum minerals
Glossary, classification by chemical type: Parker, Raymond L. 04103
Wavellite
Differential thermal analysis: Blanchard, Frank N. 04200
Zeolites
Synthesis, low temperature, analcime: Levinson, A. A. 04521
Mineral deposits, genesis
Classification
Relation to magmas, geosynclines: Smirnov, V. I. 04219
Contact metamorphic
Copper, Haiti: Kesler, Stephen E. 04188
Iron, Mexico, Colima, Cerro Nahuatl: Neilson, James M. 04132
Oxygen buffer reaction: Burt, D. M. 04136
General
Colloform textures, interpretation: Roedder, Edwin. 04230
Geochemistry, applications: Kalliokoski, J. 04242
Mineral deposits, genesis
Igneous processes
Copper, Utah, Bingham: Moore, W. J. 04239
General, review: Smirnov, V. I. 04219
Molybdenum, New Mexico: Giles, David L. 04154
Lead, zinc
Glaciation, cause: McGinnis, L. D. 04220
Metallogenic provinces
Mantle convection: Keith, M. L. 04117
Metals
Mexico, contact metamorphic: Hoffmann, Victor J. 04131
Mexico, general: Wilson, Ivan F. 04148
Ore transport
Gold-quartz veins: Helgeson, Harold C. 04125
Mercury, California: Joralemon, Peter. 04240
Ore-forming fluids
British Columbia, Bluebell mine: Ohmoto, Hiroshi. 04153
Copper, British Columbia: Chrismas, L. 04138
General: White, Donald E. 04224
Illinois, Cave-in-Rock district: Hughes, Travis Hubert. 04538
Mexico, Zacatecas, Providencia: Rye, Robert O. 04116
New Mexico, Hansonburg district: Roedder, Edwin. 04223
United States, central: Heyl, Allen V. 04238
Zinc, lead, Northwest Territories: Roedder, Edwin. 04231
Ores in igneous rocks
Thermoluminescence, hydrothermal and metasomatic effects: McDougall, David J. 03959
Pegmatite
Wyoming: Proctor, Paul Dean. 04126
Porphyry copper
Hydrothermal alteration: Guilbert, John M. 04139
Pyrometasomatic
Geochemistry: Titley, Spencer R. 04155
Silver-gold
Mexico, Tayoltita orebodies: Randall, John A. 04197
Strata-bound
Metals, biologic concentration: Boyle, R. W. 04234
Mississippi Valley: Hall, Wayne E. 04122
Zinc, lead, Canada, western: Evans, T. L. 04222
Structural controls
Lattice defects: McDougall, David J. 04121
Mexico, Naica, Fresnillo: Villasenor, Luis. 04133
Mexico, Queretaro: Mejorada, Pedro Sanchez. 04134
Molybdenum, New Mexico: Clark, K. F. 04226
United States, central: Heyl, Allen V. 04238
Sulfur
Mexico, general: Salas, Guillermo P. 04147

Mineral deposits, genesis
Supergene processes
Copper, adsorption: Clement, Stephen C. 04237
Titanium
Quebec, LaBlache Lake, magnetic deposit: Anderson, A. T. 04432
Uranium
Utah, Kane Creek: Davidson, Donald M., Jr. 04293
Veins
Manganese, Nevada, Nye County: Hewett, D. F. 04221
Silver, Ontario, Cobalt area: Petruk, William. 04130
Silver, Ontario, Cobalt district: Petruk, William. 04227
Mineral exploration
Geochemical methods
General discussion: Kalliokoski, J. 04242
Mexico, San Luis Potosi: Gomez, Manuel. 04115
Simulation technique: Dahlberg, Eric C. 04236
Soils, A horizon: Boyle, R. W. 04232
Thermoluminescence, carbonate rocks, hydrothermal ores: MacDiarmid, Roy A. 03950
Trend-surface analysis: Garrett, Robert G. 04233
Worldwide review, 1967: Cavender, Wayne S. 04375
Geological methods
Mexico, Naica, Fresnillo: Villasenor, Luis. 04133
Geophysical methods
Magnetic, limitations: Neilson, James M. 04132
Metallogenetic provinces
Mexico: Wilson, Ivan F. 04148
Mineral valuation
Diamonds, kimberlite: Dawson, J. B. 04228
Ore guides
Faulted segment, Arizona: Lowell, J. David. 04123
Geosynclines, magmatism: Smirnov, V. I. 04219
Gold veins, geochemistry: Helgeson, Harold C. 04125
Hydrothermal alteration, zoning: Guilbert, John M. 04139
Hydrothermal feldspar dikes, Mexico: Randall, John A. 04197
Metallogenic provinces, origin: Keith, M. L. 04117
United States, central: Heyl, Allen V. 04238
Programs
Union Pacific Railroad, United States, western: Melbye, Charles E. 04316
Mineral zoning
Carbonate replacement
Mexico, Durango, Mapimi district: Hoffmann, Victor J. 04131
Mineral zoning
Mercury, gold
California, Wilbur Springs: Joralemon, Peter 04240
Pegmatite
Wyoming: Proctor, Paul Dean. 04126
Porphyry copper
Arizona, San Manuel district: Lowell, J. David. 04123
Hydrothermal alteration: Guilbert, John M. 04139
Regional
Trace elements, Mississippi Valley: Hall, Wayne E. 04122
Veins
Ontario, Cobalt district: Petruk, William. 04227
Ontario, Cobalt–Gowganda area: Petruk, William. 04130
Mineralogy
Crystal growth
Colloform texture, interpretation: Roedder, Edwin. 04230
Minnesota
Economic geology
Iron, banded formation, Animikie basin, cf. Australia, South Africa: Trendall, A. F. 04294
Hydrogeology
West-central, Chippewa River watershed, resources, quality: Cotter, R. D. 04378
West-central, Mustinka–Bois de Sioux Rivers watershed: Maclay, R. W. 04424
Maps, ground water
West-central, Chippewa River watershed: Cotter, R. D. 04378
West-central, Mustinka–Bois de Sioux River watershed: Maclay, R. W. 04424
Maps, magnetic
Pine County, central airborne: U.S. Geological Survey. 04198
Mississippi
Geochemistry
Tatum salt dome, halite thermoluminescence, effects of stress: Roach, Carl H. 03951
Mississippi Valley
Economic geology
Lead, zinc, general: McGinnis, L. D. 04220
Lead, zinc, genesis: White, Donald E. 04224
Mineral deposits, genesis, tectonics: Heyl, Allen V. 04238
Geochemistry
Ore deposits, trace elements: Hall, Wayne E. 04122
Hydrogeology
Embayment, alluvial aquifers, ground-water resources: Boswell, E. H. 04517
Embayment area, ground water, quality: Jeffery, H. G. 04518
Maps, ground water
Embayment, alluvial aquifers, quality: Boswell, E. H. 04517

Mississippian
Canada
Western, stratigraphy, cf. Williston basin: Proctor, Richard M. 04509
Montana
Kibbey Formation, sedimentation: Rawson, Richard R. 04390
North Dakota
Kibbey Formation, sedimentation: Rawson, Richard R. 04390
Tennessee
Warsaw Limestone, worm borings on Bryozoa: McKinney, Frank K. 04100
United States
Williston basin, stratigraphy, cf. western Canada: Proctor, Richard M. 04509
Missouri
Paleontology
Gymnosperms, Pennsylvanian, Henry County, xeromorphy: Cridland, Arthur A. 04278
Mollusca
Cenozoic
Mexico, Baja California: Hertlein, Leo G. 04300
Jurassic–Pleistocene
California, San Diego County, guide: Moore, Ellen J. 04354
Oligocene–Miocene
California, Carrizo Plain–Temblor Range, correlation: Addicott, Warren O. 04037
Quaternary
Arizona, Winona area, lake sediments: Batchelder, George L. 04388
Molybdenum
Arizona
San Manuel district, exploration, guides: Lowell, J. David. 04123
Colorado
Rabbit Ears Range, Poison Ridge stock, exploration: Kinney, Douglas M. 03994
Exploration
Field kit, analysis: Barakso, John. 04118
Field kit, analysis: Lapointe, Guy. 04241
Hydrothermal alteration, zoning: Guilbert, John M. 04139
Mexico
Sonora, Chihuahua: Wilson, Ivan F. 04148
New Mexico
Red River district, Questa mine, occurrence: Clark, K. F. 04226
Sierra Blanca, occurrence, genesis: Giles, David L. 04154
Montana
Absolute age
Boulder batholith, emplacement time span: Tilling, Robert I. 04441
Areal geology
Deer Lodge Valley: Konizeski, R. L. 04376
Sawtooth Range, Ford Creek area: Langfield, P. M. 04067
Montana
Economic geology
Petroleum, Bell Creek field: McGregor, Alexander A. 04505
Geochemistry
Cambrian–Devonian rocks, lead isotopes: Zartman, R. E. 04111
Lewis and Clark Range, geochemical prospecting, lead–zinc: Mudge, Melville R. 04110
Geophysical surveys
Deer Lodge Valley, gravity: Cremer, E. A., 3d. 04467
Lewis and Clark Range, southeastern, magnetic, gravity: Mudge, Melville R. 04110
Hydrogeology
Deer Lodge Valley, ground water resources: Konizeski, R. L. 04376
Maps, geochemical
Lewis and Clark Range, southeastern: Mudge, Melville R. 04110
Maps, geologic
Lewis and Clark Range, southeastern: Mudge, Melville R. 04110
Roberts Mountain quadrangle: Schmidt, Robert George. 04417
Maps, gravity
Deer Lodge Valley: Cremer, E. A., 3d. 04467
Lewis and Clark Range, southeastern: Mudge, Melville R. 04110
Maps, ground water
Deer Lodge Valley: Konizeski, R. L. 04376
Maps, magnetic
Lewis and Clark Range, southeastern: Mudge, Melville R. 04110
Paleontology
Pteridophytes, Cretaceous, Hell Creek Formation, Dawson County, new: Hall, John W. 04527
Petrology
Boulder batholith, emplacement, time span: Tilling, Robert I. 04441
Sedimentary petrology
Bell Creek oil field, Muddy Sandstone, stratigraphic trap: Berg, Robert R. 04506
Kibbey Formation, textures, deposition: Rawson, Richard R. 04390
Stratigraphy
Cretaceous, southeastern, Bell Creek oil field: McGregor, Alexander A. 04505
Precambrian–Cretaceous, Lewis and Clark Range, southeastern: Mudge, Melville R. 04110
Roberts Mountain quadrangle, section: Schmidt, Robert George. 04417
Triassic–Jurassic: Carlson, C. E. 04510
Structural geology
Little Rocky Mountains, fracture analysis: Cotera, Augustus S., Jr. 04396
Nebraska
Economic geology
Petroleum, Denver basin, Dakota Sandstone traps: Exum, F. A. 04504

Nebraska
Engineering geology
Highways, application, procedures: Eversoll, Duane A. 04149
Reservoirs, Omaha area, Papillion Creek: Smith, Joseph B. 04001
Stratigraphy
Cretaceous, Dakota Sandstone, "J" sandstone, Denver basin: Exum, F. A. 04504

Nevada
Earthquakes
1954, Dixie Valley–Fairview Peak, energy release, surface strain: Meister, Laurent J. 04370
Time distribution, tidal forces influence: Tamrazyan, Gurgen P. 04484
Economic geology
Manganese, Nye County: Hewett, D. F. 04221
Petroleum, developments, 1953–67: Schilling, John H. 04181
Petroleum, Eagle Springs field: Schilling, John H. 04181
Geochemistry
Lander County, copper: Clement, Stephen C. 04237
Sheep Creek Range, western, geochemical prospecting: Gott, Garland B. 03996
Virginia City area, geochemical prospecting: Whitebread, Donald H. 03995
Geophysical surveys
Sheep Creek Range, magnetic, gravity, electrical: Gott, Garland B. 03996
Virginia City area, electrical: Whitebread, Donald H. 03995
Hydrogeology
Clayton Valley–Stonewall Flat area, ground-water resources: Rush, F. Eugene. 04312
Desert basins, ground water flow systems: Maxey, George B. 04268
Maps, geologic
Ackerman Canyon quadrangle: McKee, Edwin H. 04211
Black Mountain quadrangle, southwest quarter: Noble, Donald C. 04416
Mine Mountain quadrangle: Orkild, Paul P. 04206
Riepetown quadrangle: Brokaw, Arnold L. 04210
Yucca Flat area, surficial: Fernald, Arthur T. 04177
Maps, ground water
Clayton Valley–Stonewall Flat area: Rush, F. Eugene. 04312
Mineralogy
Manganese oxides, Nye County: Hewett, D. F. 04221
Paleontology
Insecta, Pliocene, Fernley area, new pine weevil: Sleeper, Elbert L. 04179
Stratigraphy
Devonian, Silverhorn, West Range, and Pilot formations, Lincoln County: Gordon, Joan E. 04413

Nevada
Stratigraphy
Devonian–Quaternary, Riepetown quadrangle, sections: Brokaw, Arnold L. 04210
Ordovician–Quaternary, Ackerman Canyon quadrangle, section: McKee, Edwin H. 04211
Paleozoic, Cenozoic, Black Mtn. quadrangle, section: Noble, Donald C. 04416
Quaternary, Lake Lahontan basin, correlation: Birkeland, P. W. 03976
Silurian–Quaternary, Mine Mtn. quadrangle, sections: Orkild, Paul P. 04206

New Brunswick
Economic geology
Barite, Memramcook East and Upper Dorchester areas: Hamilton, J. B. 04343
Geophysical surveys
Miramichi Bay area, magnetic anomaly, structural interpretation: McGrath, P. H. 04402
Maps, geologic
Northwestern: Pavlides, Louis. 04107
Maps, mineral resources
Memramcook East area, barite: Hamilton, J. B. 04343
Sedimentary petrology
Soils, Podzol, clay mineralogy: Kodama, H. 04330
Structural geology
Miramichi Bay area, magnetic anomaly interpretation: McGrath, P. H. 04402

New Hampshire
Maps, geologic
Connecticut Lakes–Parmachenee area: Green, John Chandler. 04298
Stratigraphy
Cambrian–Devonian, Connecticut Lakes–Parmachenee area: Green, John Chandler. 04298
Structural geology
Connecticut Lakes–Parmachenee area: Green, John Chandler. 04298

New Mexico
Absolute age
Pajarito Mountain, alkaline intrusive rocks: Kelley, Vincent C. 04296
Economic geology
Molybdenum, Red River district: Clark, K. F. 04226
Molybdenum, Sierra Blanca: Giles, David L. 04154
Zinc, lead, Hansonburg district, exploration: McDougall, David J. 04121
Engineering geology
Nuclear explosions, materials, properties, GNOME: Gard, Leonard M., Jr. 04059
Geochemistry
Halite, thermoluminescence, stress effects: Roach, Carl H. 03951
Hanover, oxygen buffer: Burt, D. M. 04136
Hansonburg district, Mex–Tex deposits, fluid inclusions: Roedder, Edwin. 04223

New Mexico
Paleontology
Gymnosperms, Triassic, Chinle Formation, new: Ash, Sidney R. 04255
Petrology
Pajarito Mountain, alkaline intrusive rocks: Kelley, Vincent C. 04296
New York
Maps, geologic
Ohio quadrangle: Nelson, Arthur E. 04003
Paleontology
Brachiopoda, Devonian, Bois Blanc Formation: Boucot, A. J. 04114
Diatoms, Pleistocene, Massena area, paleoecology: O'Brien, Neal R. 04401
Petrology
Ohio quadrangle, metamorphic and igneous rocks: Nelson, Arthur E. 04003
Sedimentary petrology
Niagara Escarpment, Medina Formation, sand facies: Martini, I. R. 04081
Normanskill Formation, turbidite greywackes, grain orientation: Onions, Diane. 04080
Structural geology
Ohio quadrangle, deformation: Nelson, Arthur E. 04003
Newfoundland
Areal geology
Wesleyville area: Williams, H. 04352
Maps, geologic
Wesleyville area: Williams, H. 04352
Paleontology
Trilobita, Cambrian, volcanic belt, New World Island: Kay, Marshall. 04443
Nickel
Analysis
Atomic absorption spectroscopy, water, chelation extraction: Fishman, Marvin J. 04308
Ontario
Cobalt district, genesis: Petruk, William. 04227
Cobalt-Gowganda area, occurrence: Petruk, William. 04130
Saskatchewan
Kipahigan Lake deposit, occurrence: Netolitzky, R. K. 04087
Niobium
Abundance
Crust, summary: Parker, Raymond L. 04103
Geochemistry
Summary: Parker, Raymond L. 04103
Nitrates
Geochemistry
Analysis, volumetric: Reichen, Laura E. 04002
Nitrogen
Geochemistry
Lakes, cycle, Wisconsin, Lake Mendota: Brezonik, Patrick Lee. 04451
North America
Absolute age
Quaternary deposits, K-Ar, methods, dates: Dalrymple, G. B. 03993
North America
Glacial geology
Pleistocene glacial interglacial stages, ice-free Arctic Ocean: Donn, William L. 04166
Quaternary, meteorological-isostatic model: Tanner, William F. 04169
Paleoclimatology
Cenozoic, cooling trend, increasing altitudes: Hamilton, Warren. 04170
Paleontology
Pteridophytes, Pennsylvanian, lycopods, morphology: Frankenberg, Julian Myron. 04450
Worm burrows, Paleozoic, stratigraphic range: Conkin, James E. 04329
Sedimentary petrology
Soils, plant communities: Eyre, S. R. 04129
Stratigraphy
Quaternary, correlation, methods: Morrison, R. B. 03989
Quaternary, correlation methods, symposium: Morrison, Roger B. 03988
Quaternary, glacial sequence, correlation with southern hemispheres: Suggate, R. P. 03992
Structural geology
Pacific margin, major faulting, transverse and peripheral: Burk, Creighton A. 04028
North Carolina
Geochemistry
Beaufort area, estuary sediments and water, zinc exchange: Duke, Thomas W. 04496
Hydrogeology
Chowan County, ground water resources: Lloyd, O. B., Jr. 04383
Maps, ground water
Chowan County: Lloyd, O. B., Jr. 04383
Maps, structure
Piedmont, eastern: Parker, John M., 3d. 04101
Petrology
Orange County, basalt, pillow structure: Wilson, William F. 04102
Sedimentary petrology
Coastal plain, soil catenas: Nettleton, W. D. 04191
Coastal plain, soil catenas: Nettleton, W. D. 04218
Structural geology
Piedmont, eastern, anticlinorium: Parker, John M., 3d. 04101
Weathering
Coastal plain, soil catenas, fragipan formation, geomorphic surfaces: Nettleton, W. D. 04218
Coastal plain, soil catenas, fragipan genesis: Nettleton, W. D. 04191
North Dakota
Sedimentary petrology
Kibbey Formation, textures, deposition: Rawson, Richard R. 04390
Stratigraphy
Triassic-Jurassic: Carlson, C. E. 04510
Northwest Territories
Economic geology
Zinc, lead, Pine Point: Evans, T. L. 04222

Northwest Territories
Economic geology
Zinc, lead, Pine Point: Roedder, Edwin, 04231
Maps, geologic
Mackenzie, Sparrow Lake–Thompson Lake area: Kretz, R. 04382
Mackenzie, Staple Lake area: Kretz, R. 04382
Maps, structure
Mackenzie, Sparrow Lake–Thompson Lake area: Kretz, R. 04382
Mackenzie, Staple Lake area: Kretz, R. 04382
Petrology
Yellowknife–Beaulieu area, pegmatites, country rocks: Kretz, R. 04382
Stratigraphy
Cambrian, Sekwi Formation, Lower, Mackenzie Mts.: Handfield, R. C. 04072
Precambrian, Hurwitz Group, Keewatin, Tavani and Kaminak Lake areas: Bell, R. T. 04071

Nova Scotia
Paleontology
Foraminifera, Oligocene–Miocene, continental slope, assemblages: Bartlett, Grant A. 04404
Sedimentary petrology
Southeastern, Goldenville Formation, structures: Harris, I. McK. 04399
Stratigraphy
Oligocene–Miocene, continental slope, paleoecology: Bartlett, Grant A. 04404

Nuclear explosions
Applications
General: Rodean, Howard C. 04096
Deformation
Halite, stress effect on thermoluminescence: Roach, Carl H. 03951
GNOME
Structural effects, mineral formation: Gard, Leonard M., Jr. 04059
Phenomena
Interpretation and prediction: Rodean, Howard C. 04096
Seismic effects
Decoupling of waves, Sterling experiment, Salmon cavity: Springer, D. 04372

Oceanography
Instruments
Grab sampler, for bottom sediments, water, organisms: Carey, Andrew G., Jr. 04560

Ohio
Paleontology
Anthozoa, Devonian, Tenmile Creek Dolomite, Lucas County: Stumm, Erwin C. 04202
Crinoidea, Pennsylvanian, Ames Limestone, new: Burke, J. J. 04331
Pteridophytes, Pennsylvanian, Upper Freeport coal: Abbott, Maxine L. 04380
Trilobita, Devonian, Silica Shale, Sylvania area: Stumm, Erwin C. 04201
Weathering
Western, Celina and Morley soils, argillic horizons, genesis: Smeck, Neil E. 04193

Oil and gas fields
Alberta
Rainbow Lake oil field: Langton, J. Roger 04508
Arizona
Dineh-bi-Keyah oil field: McKenny, Jere W. 04514
California
Bouquet Canyon oil field: Zulberti, J. L. 04423
Brea–Olinda field: Gaede, Verne F. 04418
Northwest Lost Hills oil field: Hardoin, John L. 04421
Ojai oil field, Sisar Creek area: Mitchell, William Spencer. 04420
Rio Vista gas field: Burroughs, Ernest. 04419
Rosedale oil field: Beecroft, G. W. 04422
Colorado
Greenwood gas field: Wingerter, H. R. 04464
Kansas
Greenwood gas field: Wingerter, H. R. 04464
Montana
Bell Creek oil field: Berg, Robert R. 04506
Bell Creek oil field: McGregor, Alexander A. 04505
Nevada
Eagle Springs oil field: Schilling, John H. 04181
Oklahoma
Greenwood gas field: Wingerter, H. R. 04464
Red Oak–Norris gas field: Six, David A. 04303
West Virginia
Kanawha Forest, Ripley, and Rocky Fork gas fields: Patchen, Douglas G. 04158

Oil sands
Alberta
Peace River, Athabasca, genesis, resources: Vigrass, Laurence W. 04511
Saskatchewan
Lloydminister field, occurrence, genesis: Vigrass, Laurence W. 04511

Oklahoma
Economic geology
Natural gas, Greenwood field: Wingerter, H. R. 04464
Natural gas, Red Oak–Norris field: Six, David A. 04303
Hydrogeology
Great Salt Plains, ground water levels, relation to temperature and humidity: Davis, Johnnie L. 04340
Mineralogy
Selenite crystals, Great Salt Plains, growth, factors affecting: Davis, Johnnie L. 04340
Paleontology
Crinoidea, Pennsylvanian, Wann Formation, Bartlesville area: Strimple, Harrell L. 04341
Sedimentary petrology
Northwestern, Pennsylvanian sandstones, environments, geometry: Khaiwka, Moayad Hamid. 04539
Stratigraphy
Pennsylvanian, Cherokee–Marmaton Groups, Nemaha Ridge: Cole, Joseph Glenn. 04533

Oklahoma
Structural geology
Red Oak–Norris gas field, faults, folds: Six, David A. 04303
Ontario
Absolute age
Grenville province, Rb–Sr whole–rock: Krogh, T. E. 04185
Areal geology
Crawford township, Cochrane District: Leahy, E. J. 04214
Elk Lake area: MacKean, B. E. 04315
Sudbury District, Renabie mine area: Ferguson, S. A. 04213
Whitesides township, Cochrane District: Leahy, E. J. 04215
Economic geology
Natural gas, petroleum, southwestern: Sanford, B. V. 04463
Silver, Cobalt district: Petruk, William. 04227
Silver, Cobalt–Gowganda area: Petruk, William. 04130
Silver, Elk Lake area, property descriptions: MacKean, B. E. 04315
Engineering geology
Land subsidence, Cornwall to Quebec border, Leda clays: Stermac, A. G. 04258
Maps, geologic
Chown and Lawson Townships: MacKean, B. E. 04315
Crawford township, Cochrane District: Leahy, E. J. 04214
Mickle and James Townships: MacKean, B. E. 04315
Roadhouse and Willet Townships: MacKean, B. E. 04315
Sudbury District, Renabie mine area, surficial: Ferguson, S. A. 04213
Whitesides township, Cochrane District: Leahy, E. J. 04215
Maps, magnetic
Ghost River area, airborne: Canada Geological Survey. 04557
Hornepayne area, airborne: Canada Geological Survey. 04554
Kapuskasing area, airborne: Canada Geological Survey. 04553
Kenogami River area, airborne: Canada Geological Survey. 04556
Ogoki area, airborne: Canada Geological Survey. 04558
Smoky Falls area, airborne: Canada Geological Survey. 04555
Sedimentary petrology
Niagara Escarpment, Medina Formation, sand facies: Martini, I. R. 04081
Pinery Park, Lake Huron, sediments, ripple marks: Risk, M. J. 04068
Ordovician
Arkansas
Batesville district, conodonts, biostratigraphy: Craig, William Warren. 04534
British Columbia
Peace to Muskwa Rivers, stratigraphy: Davies, E. J. L. 04065
Ordovician
Connecticut
Long Hill and Bridgeport quadrangles, stratigraphy: Crowley, William Patrick. 04302
Maine
Northeastern, Carys Mills Formation: Pavlides, Louis. 04107
New York
Normanskill Formation, turbidite greywackes: Onions, Diane. 04080
Wyoming
Bighorn Mountains, Brachiopoda, Bighorn Formation: Macomber, Richard Wiltz. 04540
Oregon
Geomorphology
Willamette Valley, relation to soil types and distribution: Parsons, R. B. 04192
Hydrogeology
Santiam River basin, lower, ground–water resources, data: Helm, D. C. 04321
Maps, geologic
Dufur quadrangle: Waters, A. C. 04415
Paleontology
Mammalia, Oligocene–Miocene, John Day Formation, gophers: Rensberger, John Marshall. 04549
Petrology
Newberry Volcano, obsidian flows, chemical variations, X–ray fluorescence study: Laidley, Richard A. 04273
Sedimentary petrology
Willamette Valley, soils, genesis: Parsons, R. B. 04192
Organic materials
Geochemistry
Marine sediments, coastal bay, bacterial decomposition: Seki, H. 04471
Orogeny
Acadian
New Hampshire–Maine, Connecticut Lakes–Parmachenee area: Green, John Chandler. 04298
Laramide
Wyoming, overthrust belt: Crosby, Gary W. 04512
Periodicity
Effects on climate, glaciation trigger: Damon, Paul E. 04167
Taconic
New Hampshire–Maine, Connecticut Lakes–Parmachenee area: Green, John Chandler. 04298
Oxygen
Geochemistry
Fugacity, buffer reaction: Burt, D. M. 04136
Isotopes
O–18, behavior in sulfate–water system: Lloyd, R. M. 04360
Fractionation, graphite–calcite–methane–carbon dioxide: Bottinga, Yan. 04545
O–18, O–16, atmospheric precipitation, Great Lakes, postglacial: Stuiver, Minze. 04062

Oxygen
Isotopes
O-18:O-16, marine phosphorites, variations: Longinelli, A. 04525
Ratios, British Columbia: Chrismas, L. 04138
Ratios, British Columbia: Ohmoto, Hiroshi. 04153
Ratios, iron-titanium oxide ores, Quebec: Anderson, A. T. 04432

Pacific Ocean
Geomorphology
Western, Erben Guyot: Boyce, R. E. 04426
Western, off California, La Jolla fan-valley: Shepard, Francis P. 04552
Geophysical surveys
Hawaiian arch, seismic: Normark, William R. 04286
Northeastern, magnetic, anomaly lineations: Luyendyk, Bruce P. 04368
Maps, bathymetric
Western, off California, La Jolla Canyon and fan-valley: Shepard, Francis P. 04552
Structural geology
North American sector, Cenozoic, tectonics: Hamilton, Warren B. 04027
Northeastern, major faulting: Burk, Creighton A. 04028

Paleobotany
Devonian
Arizona: Canright, James E. 04386
Geographic distribution
Alaska, Cenozoic, lichens: Krog, Hildur. 04410
History
Arizona: Romans, Robert C. 04384

Paleoclimatology
Cenozoic
Cooling trend, continental drift, increasing altitudes: Hamilton, Warren. 04170
Cycles
Epeirogeny and orogeny, periodicity effects: Damon, Paul E. 04167
Glaciation, air-ocean-icecap interactions, model: Eriksson, Erik. 04164
Ocean surface salinity changes, glaciation theory: Weyl, Peter K. 04162
Pleistocene, astronomical theory, thermal Rossby number: Kutzbach, John E. 04171
Quaternary, astronomical theory, insolation variations: Broecker, Wallace S. 04172
Quaternary, solar activity theory, C-14 in atmosphere: Damon, Paul E. 04140
Quaternary, solar activity theory, C-14 in atmosphere: Suess, Hans E. 04173
Theories, validity, quantitative evidence: Mitchell, J. Murray, Jr. 04141
General
Symposium, causes of change: Mitchell, J. Murray 04161
Indicators
Foraminifera, plankton, selective solution effect: Berger, Wolfgang H. 04438
Thermoluminescence of rocks, effect of microclimatic variations: Zeller, Anke N. 04013

Paleoclimatology
Indicators
Thermoluminescence, relative values: Ronca, Luciano B. 04012
Quaternary
Arctic, glacial-interglacial stages, control: Donn, William L. 04166
California, Searles Lake basin: Smith, G. I. 03975
Great Lakes region, O-18 indicator, postglacial: Stuiver, Minze. 04062
Oceans, evolution, main water masses, salinity, temperatures: Worthington, L. V. 04163
Pleistocene glaciation dynamics, model: Eriksson, Erik. 04164
Symposium: Mitchell, J. Murray 04161
Temperatures
Arctic Ocean, pack ice, effect on glaciation: Fletcher, J. O. 04165

Paleoecology
Bryozoa
Eocene-Oligocene, marine, Alabama: Askren, L. T., Jr. 04099
Diatoms
Pleistocene, estuarine, New York, Massena area: O'Brien, Neal R. 04401
Foraminifera
Holocene, marine, depth effects: Golik, Abraham. 04429
Tertiary, Nova Scotia, continental margin, Oligocene-Miocene: Bartlett, Grant A. 04404
Indicators
Bryozoa: Askren, L. T., Jr. 04099
Sedimentation, relation to plant cover: Schumm, S. A. 04283
Tertiary
Marine, Nova Scotia, continental slope: Bartlett, Grant A. 04404

Paleogeography
Cycles
Oceanographic, glacial control, Cenozoic: Bandy, Orville L. 04016
Devonian
Alberta, Zama area: McCamis, John G. 04507
Arizona, east-central: Pine, Gordon Leroy. 04542
North America, eastern, Bois Blanc-Schoharie time: Boucot, A. J. 04114
Quaternary
Florida, Keys, Pleistocene: Hoffmeister, J. E. 04292
Tertiary
California, Carrizo Plain-Temblor Range, fault slip: Addicott, Warren O. 04037
California, southern, Paleogene: Woodford, A. O. 04291
Florida, northern, indicators: Olsen, S. J. 04006
Triassic
British Columbia, Milligan Creek area, Halfway Formation: Mothersill, John S. 04078

Paleomagnetism
Applications
Quaternary correlation, principles: Cox, Allan. 03986
Arizona
Flagstaff area, Holocene basalt: Strangway, David W. 04285
Geochronology
Lava flows, application of thermoluminescence dating: Aitken, M. J. 03971
Pole positions
Quaternary glaciation onset, possible relations: Cox, Allan. 04168
Reversals
Pliocene–Pleistocene, correlation, deep-sea sediments: Glass, Billy Price. 04537
Relation to oxidation state of minerals: Wright, J. B. 04290
Terminology
"Virtual geomagnetic pole": Doell, Richard R. 04362
"Virtual geomagnetic pole": Runcorn, S. K. 04361
Paleontology
Collecting
Mollusca, California, San Diego County, guide: Moore, Ellen J. 04354
Identification
Illustrated atlas: Case, Gerard R. 04347
Methods
Correlation, dendrograph, two-dimensional tool: McCammon, Richard B. 04281
Paleozoic
Alaska
Lake Peters area, Devonian–Pennsylvanian stratigraphy: Reed, Bruce L. 04488
Canada
Hudson Bay Lowlands, reconnaissance summary: Sanford, B. V. 04265
Maine
Connecticut Lakes–Parmachenee area, Cambrian to Devonian: Green, John Chandler. 04298
New Hampshire
Connecticut Lakes–Parmachenee area, Cambrian to Devonian: Green, John Chandler. 04298
North America
Worm burrows, *Scalarituba*, stratigraphic range: Conkin, James E. 04329
Nova Scotia
Southeastern, Goldenville Formation: Harris, I. McK. 04399
Palynology
Environmental analyses
Archeological sites, possibilities: Hevly, Richard C. 04387
General
Pollen, lake sediments, seasonal redeposition, effects: Davis, Margaret. 04075
Mesozoic–Cenozoic
Catalog: Traverse, A. 04328
Methods
Electron microscopy: Martin, Paul S. 04385
Palynology
Quaternary
Maryland–West Virginia, Cranesville Swamp, profile: Cox, Donald D. 04346
Palynomorphs
Tertiary
California, San Joaquin Valley, catalog: Traverse, A. 04328
Panama
Paleontology
Foraminifera, Holocene, Gulf of Panama, fauna: Golik, Abraham. 04429
Sedimentary petrology
Gulf of Panama, Holocene sedimentation history: Golik, Abraham. 04429
Stratigraphy
Holocene, foraminiferal sediments, Gulf of Panama: Golik, Abraham. 04429
Paragenesis
Copper deposit
Haiti, Meme mine: Kesler, Stephen E. 04188
Manganese, veins
Nevada, Nye County: Hewett, D. F. 04221
Metal deposits
New Mexico: Clark, K. F. 04226
Veins
Ontario, Cobalt district: Petruk, William. 04227
Pebbles
California
Central, Santa Clara Formation, Corte Madera facies: Cummings, Jon C. 04053
Provenance
Paleogene conglomerates, California, southern: Woodford, A. O. 04291
Pegmatite
Northwest Territories
Yellowknife–Beaulieu area, occurrence: Kretz, R. 04382
Wyoming
Wind River Mountains, layered: Proctor, Paul Dean. 04126
Pelecypoda
Jurassic–Pleistocene
California, San Diego County: Moore, Ellen J. 04354
Venericardia
Tertiary, United States, Gulf and east coasts, alticostate evolution: Heaslip, William Graham. 04377
Pennsylvania
Geochemistry
South Mountain, geochemical prospecting: Dahlberg, Eric C. 04236
Maps, geologic
Southern anthracite field, west-central: Wood, Gordon H., Jr. 04245
Paleontology
Crinoidea, Pennsylvanian, Conemaugh Group, new: Burke, J. J. 04331
Structural geology
Southern anthracite field, west-central, sections: Wood, Gordon H., Jr. 04245

Pennsylvanian
Illinois
Richland County, pteridophytes, Mattoon Formation: Dennis, Robert L. 04495
Missouri
Henry County, gymnosperms, Desmoinesian: Cridland, Arthur A. 04278
North America
Pteridophytes, lycopods, morphology: Frankenberg, Julian Myron. 04450
Ohio
Carroll County, Crinoidea, Ames Limestone: Burke, J. J. 04331
Kimberly area, pteridophytes, Upper Freeport coal: Abbott, Maxine L. 04380
Oklahoma
Bartlesville area, Crinoidea, Wann Formation: Strimple, Harrell L. 04341
Nemaha Ridge, Cherokee–Marmaton Groups: Cole, Joseph Glenn. 04533
Northwestern, sedimentation: Khaiwka, Moayad Hamid. 04539
Pennsylvania
Allegheny County, Crinoidea, Conemaugh Group: Burke, J. J. 04331
West Virginia
Monongalia County, Crinoidea, Brush Creek Limestone: Burke, J. J. 04331
Yukon
Brachiopoda, spiriferids: Gorveatt, A. C. 04085
Permian
New Mexico
GNOME site, stratigraphic section: Gard, Leonard M., Jr. 04059
Yukon
Brachiopoda, spiriferids: Gorveatt, A. C. 04085
Petrofabrics
Anisotropic rocks
Grain orientation vs. elasticity, cross–correlation method: Klima, Karel. 04327
Methods
Contoured fabric diagrams, degree of preferred orientation: Hopwood, T. 04279
Quartzite
California, cross–girdle orientations, c–axis: Sylvester, A. G. 04434
Petroleum
Alabama
Fields and possibilities: Joiner, Thomas J. 04264
Production, 1965–66: White, H. Gene. 04301
Alberta
Rainbow Lake field, occurrence: Langton, J. Roger. 04508
Zama area, occurrence, reservoir properties: McCamis, John G. 04507
Arizona
Dineh–bi–Keyah field, occurrence, production: McKenny, Jere W. 04514
California
Bouquet Canyon field, occurrence: Zulberti, J. L. 04423
Petroleum
California
Brea–Olinda field, occurrence: Gaede, Vern F. 04418
Northwest Lost Hills field, occurrence: Hardoin, John L. 04421
Ojai field, Sisar Creek area,orcurrence: Mitchell, William Spencer. 04420
Rosedale field, north, south, east areas: Beecroft, G. W. 04422
Exploration
Electrical methods: Keller, George V. 0450
Geochemical methods: Law, Charles. 04322
General
United States, Canada, western, occurrence, selected papers: Warner, M. A. 04489
Montana
Bell Creek field, occurrence: Berg, Robert 04506
Bell Creek field, occurrence, production: McGregor, Alexander A. 04505
Nebraska
Denver basin, occurrence, exploration: Exum F. A. 04504
Nevada
Developments, 1953–67: Schilling, John H. 04181
Eagle Springs field, occurrence: Schilling, John H. 04181
Ontario
Southwestern, occurrence, production: Sanford, B. V. 04463
Reserves
Ultimate, Canada, Montana, North Dakot Carlson, C. E. 04510
Reservoirs
Reefs, Middle Devonian, Alberta: Langton, Roger. 04508
Sandstone, predicting location: Exum, F. 04504
Texas
South–central, occurrence: Rives, John S. 04317
Phase equilibria
Ca–Fe–Si–C–O
Oxygen buffer reaction: Burt, D. M. 0410
Clay minerals–water
Stability relations, weathering of schist: Bricker, Owen P. 04307
C–O–Fe
Diamonds, genesis: Kennedy, George C. 04229
Cu–Fe–Ni–S
Basalt magma, Hawaii: Desborough, George A. 04124
Fe–S
Sulfur, partial pressure: Giletti, B. J. 0417
Fe–Se
Experimental studies: Warren, C. Gerald. 04235
Jadeite–analcite–nepheline–albite
Pressure–temperature relations: Newton, M. S. 04498

Phase equilibria
Pb-As-S
Experimental studies, jordanite stability: Roland, George W. 04428
Photogeology
Interpretation
Remote imaging data, techniques, bibliography: Holmes, Robert F. 04183
Methods
Current trends: Miller, V. C. 04503
Photography
Catalog, Canada, geomorphologic features: Bostock, H. S. 04069
Orbital, Gemini Program, applications: Lowman, Paul D., Jr. 04176
Polymetallic ores
Idaho
Alder Creek mining district, occurrence, production: Nelson, W. H. 04109
Popular and elementary geology
Arizona
Dinosaurs, evolution: Breed, William J. 04337
Evolution
General: Moore, Ruth. 04332
Fossils
California, San Diego County, Mollusca, collecting guide: Moore, Ellen J. 04354
Precambrian
Alberta
Jasper area, Old Fort Point Formation: Weiner, J. L. 04093
Northeastern, cataclastic rocks: Watanabe, R. Y. 04092
Purcell System, argillites, geochemistry: Leask, D. M. 04086
Arizona
Santa Rita Mountains, Continental Granodiorite, new: Drewes, Harald. 04108
British Columbia
Purcell System, argillites, geochemistry: Leask, D. M. 04086
Canada
Hudson Bay Lowlands, reconnaissance summary: Sanford, B. V. 04265
Shield, stratigraphy: Wilson, M. E. 04374
Colorado
Eldora–Jamestown area, absolute age, discordance: Davis, G. L. 04522
Greenland
Stratigraphy and structure: Berthelsen, A. 04466
Michigan
Marquette and Sands quadrangles, stratigraphy: Gair, Jacob E. 04113
Minnesota
Animikie basin, iron formation, cf. Australia, South Africa: Trendall, A. F. 04294
New Mexico
Pajarito Mountain, alkaline intrusive rocks, age: Kelley, Vincent C. 04296
New York
Adirondack Mountains, Ohio quadrangle, Grenville Series: Nelson, Arthur E. 04003
Precambrian
Northwest Territories
Keewatin, Tavani and Kaminak Lake areas, Hurwitz Group: Bell, R. T. 04071
Ontario
Elk Lake area, stratigraphy: MacKean, B. E. 04315
Pteridophytes
Azolla montana, n.sp.
Cretaceous, Montana, Hell Creek Formation: Hall, John W. 04527
Lycopsida
Pennsylvanian, Ohio, Kimberly area, Upper Freeport coal: Abbott, Maxine L. 04380
Morphology
Lycopods, underground parts, Pennsylvanian: Frankenberg, Julian Myron. 04450
Rhacophyton ceratangium, West Virginia, Devonian: Andrews, Henry N. 04277
Rhabdoxylon americanum, n.sp.
Pennsylvanian, Illinois, Mattoon Formation: Dennis, Robert L. 04495
Rhacophyton ceratangium, n.sp.
Devonian, West Virginia, Hampshire shale: Andrews, Henry N. 04277
Sphenopsida
Pennsylvanian, Ohio, Kimberly area, Upper Freeport coal: Abbott, Maxine L. 04380
Stigmaria
Pennsylvanian, North America, morphology: Frankenberg, Julian Myron. 04450
Stigmariopus
Pennsylvanian, North America, morphology: Frankenberg, Julian Myron. 04450
Puerto Rico
Areal geology
Adjuntas quadrangle: Mattson, Peter H. 04243
Jayuya quadrangle: Mattson, Peter H. 04244
Maps, geologic
Adjuntas quadrangle: Mattson, Peter H. 04243
Jayuya quadrangle: Mattson, Peter H. 04244
Stratigraphy
Cretaceous–Quaternary, Adjuntas quadrangle, sections: Mattson, Peter H. 04243
Cretaceous–Quaternary, Jayuya quadrangle, nomenclature: Mattson, Peter H. 04244
Quaternary
Absolute age
C-14 and K-Ar methods, limitations: Damon, P. E. 03948
Methods, K-Ar: Dalrymple, G. B. 03993
Alaska
Cook Inlet area, correlation, radiometric dates: Karlstrom, T. N. V. 03991
Alberta
Banff area, stratigraphy: Rutter, N. W. 04091
Arctic
Polar wandering, continental drift, relation to glaciation: Cox, Allan. 04168

Quaternary
Arizona
Flagstaff area, basalts, magnetic paleointensity: Strangway, David W. 04285
San Francisco Peaks, glacial deposits: Updike, Randall G. 04391
Southeastern, Mammalia: Cantwell, R. J. 04389
Winona area, Mollusca, lake sediments: Batchelder, George L. 04388
Atlantic Ocean
Evolution of bottom water mass, effect on sediments: Worthington, L. V. 04163
Salinity and temperature changes, role in glaciation: Weyl, Peter K. 04162
California
Anza–Borrego Desert, Mammalia, Palm Springs Formation: White, John A. 04335
Searles Lake, Wisconsinan sedimentation, climate: Smith, G. I. 03975
Sierra Nevada, Pleistocene till, three-million year old icecap: Curry, Robert R. 04246
Truckee River valley, correlation: Birkeland, P. W. 03976
Colorado
Front Range, Holocene glacial history: Benedict, James B., Jr. 04529
Correlation
North America, techniques, symposium: Morrison, Roger B. 03988
Paleomagnetic method: Cox, Allan. 03986
Principles, glacial deposits: Ray, L. L. 03990
Florida
Florida Keys, Key Largo Limestone, paleogeography: Hoffmeister, J. E. 04292
General
Climate change, C–14, cosmogenic, variations: Damon, Paul E. 04140
Climate change, C–14, cosmogenic, variations: Suess, Hans E. 04173
Climatic change, astronomical theory, insolation variations: Broecker, Wallace S. 04172
Climatic change, astronomical theory, thermal Rossby number: Kutzbach, John E. 04171
Glaciation onset, increasing altitudes of continents: Hamilton, Warren. 04170
Georgia
Shoreline deposits, correlation: Hoyt, J. H. 03977
Great Lakes region
Paleoclimatology, indicator, postglacial: Stuiver, Minze. 04062
Illinois
Mammalia, Pleistocene, musk oxen: Ray, Clayton E. 04379
Northern, late-Altonian sequence, C–14 ages: Kempton, J. P. 03979
Maryland
Cranesville Swamp, palynology: Cox, Donald D. 04346
Quaternary
Montana
Deer Lodge Valley, stratigraphy: Konizeski, R. L. 04376
Nevada
Lake Lahontan area, correlation: Birkeland, P. W. 03976
New York
Massena area, Pleistocene diatoms, paleoecology: O'Brien, Neal R. 04401
Paleogeography, Massena area, Pleistocene: O'Brien, Neal R. 04401
North America
Correlation, glacial sequence, with southern hemisphere: Suggate, R. P. 03992
Correlation, soil horizons: Morrison, R. B. 03989
Glaciation, meteorological–isostatic model: Tanner, William F. 04169
Panama
Gulf of Panama, Holocene sedimentation: Golik, Abraham. 04429
Texas
Lake Lomax basin, sedimentation: Frye, J. C. 03978
United States
Southwestern, stratigraphy, alluvial material: Haynes, C. V., Jr. 03980
West Virginia
Cranesville Swamp, palynology: Cox, Donald D. 04346
Quebec
Economic geology
Iron, LaBlache Lake deposit, geochemistry, genesis: Anderson, A. T. 04432
Metals, exploration: McDougall, David J. 04121
Engineering geology
Clays, shear strength, post-peak behavior of sensitive: Ladanyi, B. 04257
Landslides, Toulnustouc River, cause, soil properties: Quigley, R. M. 04253
Soils, Outardes 2 project, properties: Sainani, U. R. 04252
Geochemistry
Igneous rocks, associated ore deposits, thermoluminescence: McDougall, David J. 03959
Noranda district, sulfide ores, Rb:Sr ratios: Reesman, R. H. 04523
Maps, mineral resources
Rouyn–Noranda area: Sharpe, J. I. 04409
Petrology
Mont Tremblant Park, granulite facies, retrograde metamorphism: Katz, Michael B. 04444
Sedimentary petrology
Toulnustouc soil, composition and fabric, of Leda clay: Quigley, R. M. 04253
Radar methods
Airborne sounding
Polar icecaps, Greenland: Walker, J. W. 04284

Radar surveys
Greenland
North-central, icecap thickness, bedrock elevation: Walker, J. W. 04284
Radioactivity
Minerals
Crystal defects, radiation effects, measurement methods: Levy, Paul W. 03983
Rare earths
Abundance
Basalt, diabase, gabbro: Frey, Fred A. 04359
Geochemistry
X-ray fluorescence spectroscopy, complex minerals: Rose, Harry J., Jr. 04275
Reefs
Alberta
Devonian, Keg River Formation, Rainbow Member: Langton, J. Roger. 04508
Devonian, Keg River Formation, upper member: McCamis, John G. 04507
Florida
Pleistocene, Key Largo Limestone, outer and back reefs: Hoffmeister, J. E. 04292
West Indies
Holocene, Saint Vincent, leeward reefs: Adams, R. D. 04436
Remote-sensing methods
General
Current trends: Miller, V. C. 04503
Reptilia
Dinosaurs
Mesozoic, Arizona, northern, evolution, popular account: Breed, William J. 04337
Rivers
General
Dynamics, morphology, elementary text: Morisawa, Marie. 04175
Rubidium
Geochemistry
Sulfide ores, Quebec, Rb:Sr ratios: Reesman, R. H. 04523
Salt tectonics
Mexico
Caprock: Salas, Guillermo P. 04147
Saskatchewan
Economic geology
Copper-nickel, Kipahigan Lake deposit: Netolitzky, R. K. 04087
Oil sands, Lloydminister field, occurrence, genesis: Vigrass, Laurence W. 04511
Sedimentary petrology
Cypress Hills Plateau, Frenchman Formation, sandstones: Chi, B. L. 04063
Eastend and Whitemud Formations, mineralogy, provenance: Byers, P. R. 04082
Stratigraphy
Cretaceous, Whitemud and Eastend Formations: Byers, P. R. 04082
Sea water
Composition
Oxygen isotope, variations through geologic time: Longinelli, A. 04525
Evolution
Quaternary, main water masses, temperature, salinity: Worthington, L. V. 04163
Sea water
Evolution
Salinity and temperature changes, cyclic, glaciation theory: Weyl, Peter K. 04162
Sedimentary rocks
Argillites
Geochemistry, Purcell System, British Columbia–Alberta: Leask, D. M. 04086
Carbonate rocks
Physical properties, thermoluminescence, hydrothermal alteration, prospecting tool: MacDiarmid, Roy A. 03950
Textures, Montana, North Dakota, Kibbey Formation: Rawson, Richard R. 04390
Chert
Physical properties, application to highway use: Kneller, William A. 04151
Clastics
Petrology, Mannville Group, Alberta, lithofacies: Clack, W. J. F. 04083
Conglomerate
Provenance, California, southern, Paleogene beds: Woodford, A. O. 04291
Evaporites
Petrology, physical properties, New Mexico, GNOME shaft: Gard, Leonard M., Jr. 04059
General
Provenance, general description, Arizona, Devonian: Pine, Gordon Leroy. 04542
Iron formation
General description, Minnesota, cf. Australia, South Africa: Trendall, A. F. 04294
Limestone
Geochemistry, 15-kb phase transition: Peselnick, Louis. 04371
Lithofacies
Alberta, Middle Devonian: Langton, J. Roger. 04508
Alberta, Middle Devonian: McCamis, John G. 04507
Oklahoma, Pennsylvanian, Cherokee–Marmaton Groups: Cole, Joseph Glenn. 04533
Oklahoma, Pennsylvanian sandstones: Khaiwka, Moayad Hamid. 04539
Paleohydrologic controls, plant cover effect: Schumm, S. A. 04283
Methods
Thermoluminescence, effect of grinding, carbonates, salt: Lewis, D. R. 03963
Thermoluminescence, limestone–dolomite systems, geologic applications: Lewis, D. R. 03968
Physical properties
Radiation damage, carbonates, measurement: Zeller, Edward J. 03969
Thermoluminescence, limestone, effect of pressure: Morency, Maurice. 03966
Thermoluminescence, trapping and emission processes: Medlin, W. L. 03965
Sandstone
General description, Oklahoma, Pennsylvanian: Khaiwka, Moayad Hamid. 04539

Sedimentary rocks
Sandstone
Petrology, Frenchman and Edmonton Formations, Saskatchewan, Alberta: Chi, B. L. 04063
Petrology, Montana, Muddy Sandstone: Berg, Robert R. 04506
Structural features, marine-bar, valley-fill, Nebraska: Exum, F. A. 04504
Shale
Geochemistry, boron abundances, Colorado: Cody, Robert Dow. 04532
Geochemistry, ion exchange capacity, environmental indicator: Williams, H. H. 04089
Turbidite
Fabric, New York, Normanskill Formation: Onions, Diane. 04080
Sedimentary structures
Bedding
Arctic, Baffin Bay, cores: Blee, John J. 04400
General
Nova Scotia, Goldenville Formation: Harris, I. McK. 04399
Ripple marks
Ontario, Lake Huron sediments: Risk, M. J. 04068
Sedimentation
Experimental studies
Sediment diffusion, nonuniform flow field: Apmann, Robert Proctor. 04460
Ocean currents
Atlantic Ocean, continental rise, anti-dunes, migration: Fox, P. J. 04492
Rates
Atlantic Ocean, North American Basin: Pratt, Richard M. 04519
Paleohydrologic controls, plant cover effect: Schumm, S. A. 04283
Sediments
Clastic
Heavy minerals, Louisiana, Citronelle Formation: Rosen, Norman Charles. 04543
Clay
Geochemistry, Hawaiian Islands, authigenic marine: Moberly, Ralph, Jr. 04282
Diagenesis
Experimental studies, quartz sand, carbonate rocks: Sharma, Ghanshyam D. 04427
Environment
Deep-sea, Atlantic Ocean, North American Basin: Pratt, Richard M. 04519
Ocean, Arctic, Baffin Bay, cores: Blee, John J. 04400
General
General description, Arctic, Baffin Bay, cores: Blee, John J. 04400
General description, Atlantic Ocean, North American Basin: Pratt, Richard M. 04519
Provenance, absolute age, Colorado River delta: Muffler, L. J. Patrick. 04462
Sedimentary structures, size analysis, heavy minerals, Lake Huron: Risk, M. J. 04068
Sediments
Geochemistry
Marine plankton, carbon isotope composition, diagenesis: Degens, E. T. 04440
Wisconsin, Madison area, Lake Mendota sediments, sulfur: Nriagu, Jerome O. 0447[illegible]
Mineral composition
Chesapeake Bay, suspended: Schubel, Jerry Robert. 04548
Physical properties
Chesapeake Bay, suspended, size analysis: Schubel, Jerry Robert. 04548
Continental margin, California, La Jolla canyon, magnetic fabric: Rees, Anthony I 04425
Kentucky, Paducah West and Metropolis quadrangles: Finch, Warre I. 04004
Sand
Heavy minerals, Arizona, Yavapai County: Gambell, Neil. 04397
Seismic methods
Applications
Highway construction, subsurface geology: Mitchell, Robert E. 04144
Interpretation
Ice, velocity anisotropy, petrofabric relation: Bennett, Hugh Frederick. 04544
Techniques
Frequency-wave-number spectra, determination: Iyer, H. M. 04289
Seismic surveys
California
Diablo and Gabilan Ranges, San Andreas fault area, crustal studies: Stewart, Samuel W. 04055
Gabilan Range, Salinas area, stress accumulation at depth: Eisler, Joseph D. 04052
Gulf of Mexico
Sigsbee Deep, Bay of Campeche, salt diapirs: Worzel, J. Lamar. 04465
Mexico
Baja California, continental margin, reflection profiles: Normark, William R. 04297
Pacific Ocean
Hawaiian arch, northeast of islands: Normark, William R. 04286
Seismology
Elastic waves
Acoustic, Lake Superior, velocity: Browning, David G. 04468
Body waves, spectra, effective Q: DeBremaecker, J.-Cl. 04187
Frequency-wave-number spectra, determination method: Iyer, H. M. 0429[illegible]
Longitudinal, in granite: Simmons, Gene. 04073
PcP phases, core-mantle boundary properties: Buchbinder, Goetz G. R. 04366
S-phases, upper-mantle structure, Texas: Shurbet, D. H. 04254
Spherical wave propagation, compressible media, model: Faccioli, Ezio. 04454

Selenium
Geochemistry
Ferroselite, synthesis: Warren, C. Gerald. 04235

Shorelines
Ancient
Florida, Tertiary, mammalian indicators: Olsen, S. J. 04006

Silurian
Arkansas
Batesville district, conodonts, biostratigraphy: Craig, William Warren. 04534
British Columbia
Peace to Muskwa Rivers, stratigraphy: Davies, E. J. L. 04065
Canada
James Bay lowland, Cephalopoda, *Discosorus–Huronia* faunas: Flower, Rosseau H. 04381
Indiana
Northern, Foraminifera, arenaceous, descriptions, zonation: Mound, Michael C. 04550
Kentucky
Pulaski County, stratigraphy: Helton, Walter L. 04182
Maine
Northeastern, Carys Mills Formation: Pavlides, Louis. 04107

Silver
Geochemistry
Concentrations, ore minerals: Hall, Wayne E. 04122
Mexico
Durango, Mapimi district, occurrence: Hoffmann, Victor J. 04131
Metallogenetic provinces: Wilson, Ivan F. 04148
Naica, Fresnillo, exploration: Villasenor, Luis. 04133
Queretaro, La Negra, occurrence: Mejorada, Pedro Sanchez. 04134
San Luis Potosi, ore guides: Gomez, Manuel. 04115
Tayoltita, occurrence: Randall, John A. 04197
New Mexico
Red River district, occurrence: Clark, K. F. 04226
Ontario
Cobalt district, mineralogy, genesis: Petruk, William. 04227
Cobalt–Gowganda area, occurrence, genesis: Petruk, William. 04130
Elk Lake area, property descriptions: MacKean, B. E. 04315

Soils
California
Fort Bragg area, podzolic, genesis: Gardner, Robert Alexander. 04446
Correlation
Quaternary, North America: Morrison, R. B. 03989

Soils
Engineering properties
Canada, Ottawa–St. Lawrence valleys, Leda clay, shear strength: Crawford, Carl B. 04195
Kentucky, Paducah West–Metropolis quadrangles: Finch, Warren I. 04004
Ontario, Cornwall to Quebec border, Leda clays: Stermac, A. G. 04258
Preconsolidation pressures: Kenney, T. Cameron. 04249
Quebec, Outardes 2 project: Sainani, U. R. 04252
Quebec, shear strength, sensitive clays: Ladanyi, B. 04257
Remolded clay, static and dynamic skin friction response: Raba, Carl Franz, Jr. 04458
Shear strength, consolidation, soft sensitive clays, new concepts: Kenney, T. Cameron. 04259
Silty, strength, field vane testing: Blight, G. E. 04250
Textbook: Scott, Ronald F. 04344
Geochemistry
A–horizon, trace elements: Lapointe, Guy. 04241
Organic material, manganese reactions: Rosell, Ramon Antonio. 04447
Trace elements, A horizon: Boyle, R. W. 04232
Iowa
Aggregates, physical and chemical properties: Tabatabai, M. A. 04190
New Brunswick
Podzol, clay mineralogy: Kodama, H. 04330
North America
Development, plant communities: Eyre, S. R. 04129
North Carolina
Coastal plain, catenas, composition, fragipan genesis: Nettleton, W. D. 04191
Coastal plain, catenas, fragipan formation, geomorphic surfaces: Nettleton, W. D. 04218
Ohio
Western, Celina and Morley soils, argillic horizons, genesis: Smeck, Neil E. 04193
Oregon
Willamette Valley, genesis, relation to geomorphology: Parsons, R. B. 04192
Physical properties
Clay suspensions, flow properties, changes with reduction: Alcordo, Isabelo Suelo. 04445
Quebec
Toulnustouc soil, composition and fabric, cf. Leda clay: Quigley, R. M. 04253
Washington
Southwestern, soils, Al exchange capacity, drying effects: Westfall, Dwayne Gene. 04448

South Carolina
Hydrogeology
Berkeley and Charleston Counties, ground-water regimen, impact of canals: Siple, George E. 04000
Stratigraphy
Tertiary, coastal plain, sea-level changes: Colquhoun, D. J. 04009
South Dakota
Engineering geology
Landslides, Pierre Shale: Bruce, Richard L. 04150
Spectroscopy
Absorption
Atomic, electrothermal atomization: Woodriff, Ray. 04271
Atomic, geologic samples, major constituents: Galle, O. Karmie. 04270
Atomic, Pb, Co, Ni in fresh water, chelation-extraction: Fishman, Marvin J. 04308
Activation analysis
Age determination, crystal defects: Townsend, P. D. 03984
Geologic materials, trapping parameters, determination tools: Braunlich, P. 03985
Gold, fire-assay separation: Rowe, J. J. 03997
Instruments, design, special: Lewis, D. R. 03964
Technique, uranium in water: Edwards, Kenneth W. 04326
Thermoluminescence, limestone, dolomite, salt: Lewis, D. R. 03963
Thermoluminescence, minerals, radiation effects: Levy, Paul W. 03983
Thermoluminescence, research review, Univ. Wisconsin: Daniels, Farrington. 03982
Mass
Spark source, major and minor elements: Carver, Riley D. 04276
Ultraviolet
Calcite, thermoluminescence peaks, experimental study: Vaz, J. E. 03974
X-ray fluorescence
Igneous rocks, compositional variations, geologic history: Laidley, Richard A. 04273
Micro, selected applications: Cuttitta, Frank. 04274
Rare earths in complex minerals: Rose, Harry J., Jr. 04275
Statistical methods
Correlation
Dendrograph, two-dimensional tool: McCammon, Richard B. 04281
Economic geology
Trend-surface analysis: Garrett, Robert G. 04233
Geochemistry
Distribution curve, simulation technique, geochemical prospecting: Dahlberg, Eric C. 04236
Stocks
Colorado
Rabbit Ears Range, Poison Ridge porphyry: Kinney, Douglas M. 03994
Stocks
Petrology
Zoning: Giles, David L. 04154
Stratigraphy
Nomenclature
Rules, Alberta Soc. Petroleum Geologists: Hawryszko, J. W. 04079
Strontium
Isotopes
British Columbia: Chrismas, L. 04138
Transport in clay suspensions, model river system: Purushothaman, Krishnier. 04528
Sulfur
Canada
Western, isotopes: Evans, T. L. 04222
Geochemistry
Carbonate replacement deposits: Titley, Spencer R. 04155
Lake sediments, Wisconsin, Lake Mendota bottom muds: Nriagu, Jerome O. 04473
Partial pressure, measurement: Giletti, B. J. 04137
Isotopes
Ratios, British Columbia: Chrismas, L. 04138
Mexico
Ore deposits, general: Salas, Guillermo P. 04147
Surveys
History
Federal and state: Agnew, Allen F. 04349
Talc
Alabama
Tallapoosa and Chambers Counties, occurrence: Neathery, Thornton L. 04323
Tantalum
Abundance
Crust, summary: Parker, Raymond L. 04103
Geochemistry
Summary: Parker, Raymond L. 04103
Tectonics
Areal studies
California, Cenozoic, relation to Pacific basin: Hamilton, Warren B. 04027
California, Coast Ranges, squeezing between granitic blocks, high fluid potentials: Berry, Frederick A. F. 04048
California, Hayward, Calaveras, Pleasanton faults: Radbruch, Dorothy H. 04050
California, history, relation to East Pacific Rise: Crowell, John C. 04026
California, San Andreas and Calaveras faults, recent movement: Rogers, Thomas H. 04049
California, San Andreas fault, Cholame, Taft-Maricopa areas: Howard, John H. 04047
California, San Andreas fault, large slip, evidence: Gastil, R. Gordon. 04054
California, San Andreas fault, movement, Pajaro Gap: Maddock, Marshall E. 04034
California, San Andreas fault, post-Cretaceous slip: Hill, Mason L. 04035

Tectonics
Areal studies
California, San Andreas fault, post-Cretaceous slip: Wentworth, Carl M. 04036
California, San Andreas fault, recent movement: Brown, Robert D., Jr. 03953
California, San Andreas fault, recent movement: Hofmann, Renner B. 04046
California, San Andreas fault, recent movement: Wallace, Robert E. 03952
California, San Andreas fault system, active, inactive areas: Allen, Clarence R. 04041
California, southern, evolution: Yeats, Robert S. 04025
Cape Cod to Cape Hatteras, Tertiary history: Richards, Horace G. 04010
Cordilleran foreland, mechanics: Sales, John K. 04513
United States, western, Cenozoic, relation to Pacific basin: Hamilton, Warren B. 04027
Wyoming, western, overthrust belt: Crosby, Gary W. 04512
Mineral belts
Genesis, mantle convection: Keith, M. L. 04117
United States, western: Clark, K. F. 04226
Processes
Flow in mantle, glacial loading effects: McConnell, Robert K., Jr. 04186
Global tectonics, mechanics, causes: Isacks, Bryan. 04365
Mantle convection, effect of low-viscosity layer: McFadden, C. P. 04491

Tennessee
Paleontology
Bryozoa, worm borings, Mississippian, Warsaw Limestone: McKinney, Frank K. 04100

Tertiary
Alabama
Saint Stephen area, Bryozoa, paleoecology: Askren, L. T., Jr. 04099
Arizona
Santa Rita Mountains, new formations, absolute age: Drewes, Harald. 04108
California
Caliente Range, southeastern, Miocene rocks, fault effects: Clifton, H. Edward. 04040
Carrizo Plain–Temblor Range, correlation across fault, Mollusca: Addicott, Warren O. 04037
Gualala area, stratigraphy: Wentworth, Carl M. 04036
San Andreas fault area, Miocene phosphatic facies, correlation: Dickert, Paul F. 04039
San Joaquin Valley, palynomorphs, catalog: Traverse, A. 04328
Santa Cruz Mountains area, correlation across fault: Clark, Joseph C. 04038
Southern, Paleogene conglomerates: Woodford, A. O. 04291

Tertiary
Caribbean region
Foraminifera, orbitolinids, Eocene, taxonomic revision: Butterlin, Jacques. 04324
Florida
Cirripedia, Miocene, barnacle: Ross, Arnold. 04199
Georgia
Brunswick area, Lake City Formation, Eocene, echinoids: Kier, Porter M. 04127
Montana
Deer Lodge Valley, stratigraphy: Konizeski, R. L. 04376
Nevada
Fernley area, Insecta, Pliocene, new pine weevil: Sleeper, Elbert L. 04179
North America
Sea-level changes, symposium: Tanner, William F. 04015
Nova Scotia
Continental slope, Oligocene–Miocene sediments, Foraminifera: Bartlett, Grant A. 04404
Oregon
Mammalia, John Day Formation, gophers: Rensberger, John Marshall. 04549
Paleoclimatology
Cooling trend, causes: Hamilton, Warren. 04170
South Carolina
Coastal plain, stratigraphy, sea-level changes: Colquhoun, D. J. 04009
Texas
Coastal Plain, stratigraphy, shoreline positions: Wilson, John A. 04007
San Jacinto County, stratigraphy, aquifers: Sandeen, W. M. 04217
South-central, stratigraphy: Rives, John S. 04317
United States
Atlantic coast, shoreline displacements, tectonic control: Richards, Horace G. 04010
Gulf and east coasts, Pelecypoda, venericards, evolution: Heaslip, William Graham. 04377
Southeastern, sea-level changes: Tanner, William F. 04008
Worldwide
Sea-level changes, glacial control: Bandy, Orville L. 04016

Texas
Economic geology
Petroleum and natural gas, south-central, occurrence: Rives, John S. 04317
Hydrogeology
Polk County, ground-water resources: Tarver, George R. 04216
San Jacinto County, ground-water resources: Sandeen, W. M. 04217
Maps, ground water
San Jacinto County: Sandeen, W. M. 04217
Paleontology
Foraminifera, Cretaceous, Kemp Clay, index species: Esker, George C., 3d. 04406

Texas
Paleontology
Foraminifera, Cretaceous, Taylor Marl: Esker, George C., 3d. 04405
Stratigraphy
Cenozoic, San Jacinto County: Sandeen, W. M. 04217
Cretaceous–Tertiary, south-central, relation to buried volcanic domes: Rives, John S. 04317
Pleistocene, lacustrine sediments, Lake Lomax basin: Frye, J. C. 03978
Tertiary, shoreline positions: Wilson, John A. 04007
Structural geology
Gulf of Mexico margin, upper mantle: Shurbet, D. H. 04254
Sierra Madera, central uplift, deformation pattern: Wilshire, H. G. 04305
South-central, buried volcanic domes, faults: Rives, John S. 04317
Thermal springs
California
Brines, Salton Sea area: White, Donald E. 04224
Mercury: Joralemon, Peter. 04240
Thermodynamic properties
Electrochemical
Fe-reducing environment, equilibrium, Eh: Doyle, Roger Whitney Stevens. 04535
Fugacity
Copper ore, Haiti: Kesler, Stephen E. 04188
Oxygen, skarn: Burt, D. M. 04136
General
Gold-quartz veins: Helgeson, Harold C. 04125
Lattice defects
Mineral exploration: McDougall, David J. 04121
Partial pressure
CO_2, mantle: Kennedy, George C. 04229
Sulfur, measurement: Giletti, B. J. 04137
Thermoluminescence
Applications
Age determination, crystal defects, guide lines for use: Townsend, P. D. 03984
Age determination, lava flows, historic, evaluation: Aitken, M. J. 03971
Age determination, pottery, clay minerals: Siegel, Frederic R. 03954
Age determination, technique, new: Zeller, Edward J. 03970
Carbonate rocks, hydrothermal ores, exploration tool: MacDiarmid, Roy A. 03950
Geochronology, thermoluminescent dosimetry method: Johnson, Noye M. 03949
Geologic problems, radiation effects, mineral defects: Levy, Paul W. 03983
Mineral exploration: McDougall, David J. 04121
Paleoclimatology, relative thermoluminescence: Ronca, Luciano B. 04012
Thermoluminescence
Applications
Paleothermometry, magma temperatures, from wall rock: Johnson, Noye M. 03960
Radiation damage detection, cf. electron spin resonance: Zeller, Edward J. 03969
Bibliographies
Geological materials: Grogler, Norbert. 03955
Calcite
Experimental studies, effects of ultraviolet illumination: Vaz, J. E. 03974
Growth curves, 600°K peaks: Medlin, W. L. 03973
Clay minerals
Changes when fired: Siegel, Frederic R. 03954
Experimental studies
Calcite, dolomite, halite, effect of grinding: Lewis, D. R. 03963
Calcite, effects of ultraviolet illumination: Vaz, J. E. 03974
Calcite, growth curves, 600°K peaks: Medlin, W. L. 03973
Carbonate and other minerals, trapping and emission processes: Medlin, W. L. 03965
Dating of pottery: Ralph, Elizabeth K. 03972
Geological materials, Univ. Wisconsin, research review: Daniels, Farrington. 03982
Halite, nuclear test-sites, stress effects: Roach, Carl H. 03951
Ice, glacial, relation to stress and flow history: Ronca, L. B. 03967
Limestone, syenite, effects of pressure: Morency, Maurice. 03966
Limestone-dolomite systems, geologic applications: Lewis, D. R. 03968
Lithium fluoride, annealing characteristics, mechanisms: Cameron, John R. 03961
Lithium fluoride, supralinearity: Zimmerman, D. W. 03962
Silicate rocks, proton-excited efficiencies, mineral phases: Nash, Douglas B. 03958
General
Geologic materials, NATO Advanced Research Research Inst. conference: McDougall, David J. 03981
Halite
Low-temperature, stress effects, nuclear test-sites: Roach, Carl H. 03951
Instruments
Design, special features: Lewis, D. R. 03964
Interpretation
Glaciated areas, effect of deglaciation, solar radiation: Zeller, Anke N. 04011
Igneous rocks, associated ore deposits: McDougall, David J. 03959
Methods
Geologic materials, trapping parameters, determination: Braunlich, P. 03985
Rock outcrop sampling, microclimatic variations effect: Zeller, Anke N. 04013
Sample preparation, effect of grinding on results: Lewis, D. R. 03963

Tin
Colorado
Lake George area, exploration, occurrence: Hawley, C. C. 03998
Titanium
Quebec
LaBlache Lake deposit, geochemistry, genesis: Anderson, A. T. 04432
Trace-element analyses
Chondrites
Abundances, volatile elements cf. Earth's crust: Anders, Edward. 04345
Copper ore
Nevada, Lander County, X-ray fluorescence: Clement, Stephen C. 04237
Evaporites
New Mexico, Salado Formation, GNOME shaft: Gard, Leonard M., Jr. 04059
Lake waters
California, High Sierras: Bradford, G. R. 04472
Manganese ores
Nevada, spectroscopic: Hewett, D. F. 04221
Marine organisms
Metals: Boyle, R. W. 04234
Natural gas
United States, helium: Moore, B. J. 04106
Ore deposits
Mississippi Valley, spectrographic: Hall, Wayne E. 04122
Ore-forming fluids
Fluid inclusions, brines: White, Donald E. 04224
Sphalerite
Canada, western: Evans, T. L. 04222
Sulfides
Hawaii, basalt, electron probe: Desborough, George A. 04124
Tracks and trails
Nova Scotia
Cambrian(?), Goldenville Formation, worm mounds, burrows: Harris, I. McK. 04399
Scalarituba missouriensis
Paleozoic, North America, distribution, worm burrows: Conkin, James E. 04329
Worm tubes
Tennessee, Warsaw Limestone: McKinney, Frank K. 04100
Triassic
Arizona
Northern, stratigraphy and paleontology, popular account: Breed, William J. 04337
British Columbia
Milligan Creek area, Halfway Formation, paleogeography: Mothersill, John S. 04078
Canada
Western, stratigraphy: Carlson, C. E. 04510
Massachusetts
Mount Tom Range, volcanic plugs: Foose, Richard M. 04280
Montana
Stratigraphy: Carlson, C. E. 04510
Triassic
New Mexico
Fort Wingate, gymnosperms, new, Chinle Formation: Ash, Sidney R. 04255
North Dakota
Stratigraphy: Carlson, C. E. 04510
Trilobita
Cambrian
Newfoundland, New World Island: Kay, Marshall. 04443
Dechenella lucasensis
Devonian, Ohio, Silica Shale: Stumm, Erwin C. 04201
Dechenella witherspooni, n.sp.
Devonian, Michigan, Alpena Limestone: Stumm, Erwin C. 04201
Tungsten
Colorado
Lake George area, exploration, occurrence: Hawley, C. C. 03998
United States
Absolute age
Central, kimberlite: Dawson, J. B. 04228
Quaternary alluvial material, southwestern, general listing: Haynes, C. V., Jr. 03980
Earthquakes
1966, summary: vonHake, Carl A. 04128
1965, summary: vonHake, Carl A. 04336
Body waves, Q from spectral shift: DeBremaecker, J.-Cl. 04187
Seismicity, western: U.S. Bureau of Reclamation. 04180
Economic geology
Construction materials, dimension stone, occurrence, production: Barton, William R. 04105
Hydrothermal ores, carbonate rocks, thermoluminescent prospecting: MacDiarmid, Roy A. 03950
Mineral resources, western, exploration, Union Pacific Railroad program: Melbye, Charles E. 04316
Natural gas, analyses, helium: Moore, B. J. 04106
Western, mineral belts: Clark, K. F. 04226
Economic geology
Petroleum, western, occurrence, selected papers: Warner, M. A. 04489
Geochemistry
Hydrothermal ores, carbonate rocks, thermoluminescent prospecting: MacDiarmid, Roy A. 03950
Natural gas, analyses, helium: Moore, B. J. 04106
Phosphorites, marine, oxygen isotope composition: Longinelli, A. 04525
Geomorphology
Atlantic coast, Tertiary shorelines, tectonic control: Richards, Horace G. 04010
Eastern, continental shelf, Cretaceous–Cenozoic development: Garrison, Louis Eldred. 04536
Southeastern, marine terraces, Cenozoic: Alt, David. 04014

United States
Geophysical surveys
Heat flow, provinces, plutonic rocks: Roy, Robert F. 04526
Transcontinental, aeromagnetic, experimental: Zietz, Isidore. 04262
Geothermal energy
Potential sources: Whiting, Robert L. 04263
Hydrogeology
Southwestern, ground-water levels, 1961–65: U.S. Geological Survey. 04470
Maps, magnetic surveys, index
Airborne, shipborne, ground coverage: Zietz, Isidore. 04262
Paleontology
Pelecypoda, Tertiary, Gulf and east coasts, alticostate venericards: Heaslip, William Graham. 04377
Petrology
Northwestern, Cenozoic, mesa basalt sheet: Wheeler, H. E. 04481
Stratigraphy
Mississippian, Williston basin, relation to western Canada: Proctor, Richard M. 04509
Quaternary, alluvial materials, southwestern: Haynes, C. V., Jr. 03980
Tertiary, sea-level changes, southeautern: Tanner, William F. 04008
Structural geology
Southeastern, isostasy, Cretaceous to Miocene: Tanner, William F. 04008
Western, tectonics, Cenozoic, relation to Pacific basin: Hamilton, Warren B. 04027
Western, tectonics, Cordilleran: Sales, John K. 04513

Uplifts
New Mexico
Pajarito Mountain, Laramide dome: Kelley, Vincent C. 04296

Uranium
Analysis
Activation, natural waters: Edwards, Kenneth W. 04326
Isotopes
U-234, U-238, ground water, isotope dilution approach: Osmond, J. K. 04077
Utah
Kane Creek, genesis, occurrence: Davidson, Donald M., Jr. 04293

Utah
Absolute age
Bingham, rocks, ore: Moore, W. J. 04239
Economic geology
Metals, Park City district: Garrett, Robert G. 04233
Uranium, Kane Creek, occurrence: Davidson, Donald M., Jr. 04293
Hydrogeology
Sevier Desert, ground-water resources: Mower, R. W. 04469

Utah
Maps, geologic
Monte Cristo property, Kane Creek: Davidson, Donald M., Jr. 04293
Sevier Desert: Mower, R. W. 04469
Maps, ground water
Sevier Desert: Mower, R. W. 04469
Mineralogy
Clay minerals, Kane Creek, uranium-bearing veins: Davidson, Donald M., Jr. 04293

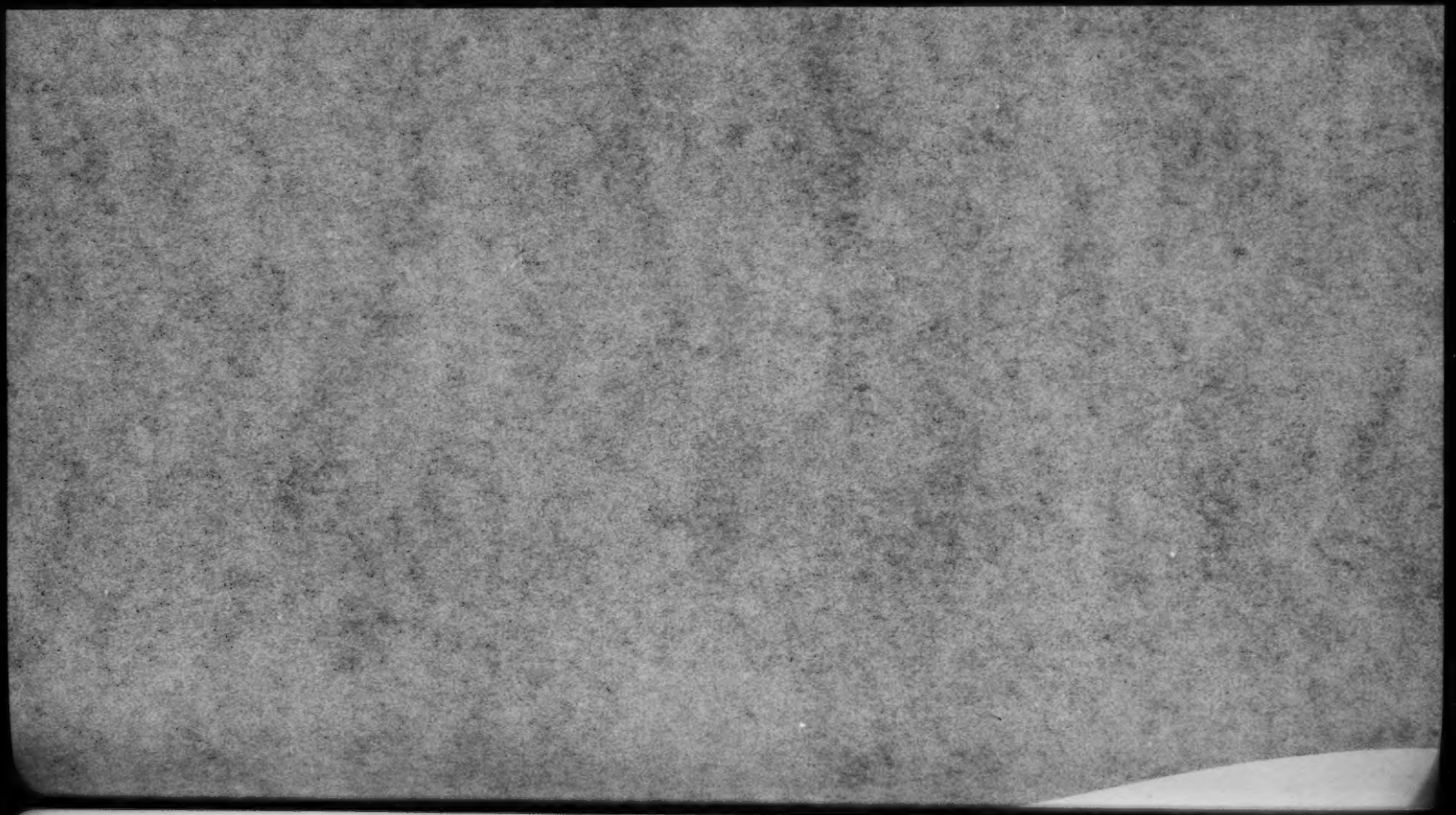
Veins
Genesis
Manganese, Nevada, Nye County: Hewett, D. F. 04221
Gold-quartz
Genesis: Helgeson, Harold C. 04125
Mineralogy
Ontario, Cobalt district: Petruk, William. 04227
Ontario, Cobalt-Gowganda area: Petruk, William. 04130
Structure
Colloform texture, interpretation: Roedder, Edwin. 04230
Uranium bearing
Utah, Kane Creek: Davidson, Donald M., Jr. 04293

Vermont
Mineralogy
Collecting localities: Grant, Raymond W. 04339

Vertebrata
Atlas
Illustrated, selected specimens: Case, Gerard R. 04347

Virginia
Absolute age
Petersburg Granite, Precambrian, weathering effects: Bottino, Michael L. 04497
Economic geology
Mineral resources, Bramwell (W.Va.) area: Englund, Kenneth J. 04205
Geomorphology
Wachapreague lagoon and barrier islands, genesis: Newman, Walter S. 04551
Maps, geologic
Bramwell (W.Va.) area: Englund, Kenneth J. 04205
Stratigraphy
Bramwell (W.Va.) area, new names: Englund, Kenneth J. 04205
Structural geology
Atlantic coast, subsidence, Holocene: Newman, Walter S. 04551
Weathering
Petersburg Granite, effects on Rb-Sr ratios: Bottino, Michael L. 04497

Volcanoes
Alaska
Katmai National Monument, volcanic and seismic activity: Ward, P. L. 04480
Katmai range, magma reservoirs, evidence: Kubota, S. 04479

Volcanoes
Central America
Circum-Caribbean region, magma similarity: Weyl, R. 04482
Costa Rica
Irazu, Poas, activity, 1964–65: Krushensky, R. D. 04478
West Indies
Circum-Caribbean region, magma similarity: Weyl, R. 04482
Washington
Areal geology
Okanogan County, northern, magnesite deposits: Fox, Kenneth F., Jr. 04112
Economic geology
Magnesite, Okanogan County, northern: Fox, Kenneth F., Jr. 04112
Geochemistry
Southwestern, soils, Al exchange capacity, drying effects: Westfall, Dwayne Gene. 04448
Hydrogeology
Pullman-Moscow basin, ground-water resources, problems: Crosby, James W., 3d. 04325
Maps, geologic
Greenacres quadrangle: Weis, P. L. 04203
Okanogan County, northern: Fox, Kenneth F., Jr. 04112
Petrology
Mount Pilchuk, quartz monzonite, plagioclase zoning: Wiebe, Robert A. 04499
Stratigraphy
Greenacres quadrangle, sections: Weis, P. L. 04203
Weathering
Chemical
Humid climate, degree from silica-to-alumina ratio: Ruxton, Bryan P. 04431
Geochemistry
Maryland, Baltimore area, schist, silicate-water interaction: Bricker, Owen P. 04307
Nevada, copper ore: Clement, Stephen C. 04237
Granite
Massachusetts, Virginia, effects on Rb-Sr ages: Bottino, Michael L. 04497
North Carolina
Coastal plain, soil catenas, fragipan formation, geomorphic surfaces: Nettleton, W. D. 04218
Coastal plain, soil catenas, fragipan genesis: Nettleton, W. D. 04191
Ohio
Western, Celina and Morley soils, argillic horizons, genesis: Smeck, Neil E. 04193
Wells and drill holes
Florida
Everglades National Park, drillers' logs: U.S. Army Corps of Engineers. 04178
Gulf of Mexico
Cores, clay minerals: Scafe, Donald William. 04547
Wells and drill holes
New Mexico
GNOME shaft, section: Gard, Leonard M., Jr. 04059
Oregon
Santiam River basin, lower, well records and drillers' logs: Helm, D. C. 04321
Texas
Polk County, well records and drillers' logs: Tarver, George R. 04216
San Jacinto County, water-well logs: Sandeen, W. M. 04217
West Indies
Geomorphology
Saint Vincent, leeward reefs: Adams, R. D. 04436
Volcanology
Circum-Caribbean region, magma similarity: Weyl, R. 04482
West Virginia
Economic geology
Mineral resources, Bramwell area: Englund, Kenneth J. 04205
Natural gas, Kanawha Forest, Ripley, and Rocky Fork fields: Patchen, Douglas G. 04158
Maps, geologic
Bramwell area: Englund, Kenneth J. 04205
Paleontology
Crinoidea, Pennsylvanian, Brush Creek Limestone, new: Burke, J. J. 04331
Palynology, Quaternary, Cranesville Swamp, profile: Cox, Donald D. 04346
Pteridophytes, Devonian, Hampshire shale, new: Andrews, Henry N. 04277
Stratigraphy
Bramwell area, new names: Englund, Kenneth J. 04205
Wisconsin
General
History of research, thermoluminescence, Univ. Wisconsin: Daniels, Farrington. 03982
Geochemistry
Lake Mendota, nitrogen cycle: Brezonik, Patrick Lee. 04451
Madison area, Lake Mendota sediments, sulfur compounds: Nriagu, Jerome O. 04473
Worms
Scalarituba missouriensis
Paleozoic, North America, distribution, filled burrows: Conkin, James E. 04329
Wyoming
Maps, geologic
Virginia Dale area: Eggler, D. H. 04295
Paleontology
Brachiopoda, Ordovician, Bighorn Formation, Bighorn Mts.: Macomber, Richard Wiltz. 04540
Petrology
Pegmatite, Wind River Mountains: Proctor, Paul Dean. 04126
Virginia Dale ring-dike complex: Eggler, D. H. 04295

Wyoming
Structural geology
Cordilleran foreland, tectonics, mechanism: Sales, John K. 04513
Southwestern, overthrust belt, tectonic history: Crosby, Gary W. 04512
X-ray diffraction analysis
Data
Apatite, composition fluctuations: Skinner, H. C. W. 04272
Manganese ores, Nevada, Nye County: Hewett, D. F. 04221
Powder patterns, standard: Swanson, H. E. 04358
Soils, Manitoba, Winnipeg area, swelling clays: Quigley, Robert M. 04260
Methods
Apatite, composition fluctuations, monitoring: Skinner, H. C. W. 04272
Quartz in airborne dust, 0.5- to 2-micron size range: Oberg, Maurice. 04356
Yukon
Paleontology
Brachiopoda, Permo-Pennsylvanian, spiriferids: Gorveatt, A. C. 04085
Zinc
British Columbia
Big Ledge deposit, genesis: Raham, G. O. 04088
Bluebell mine, genesis: Ohmoto, Hiroshi. 04153
Canada
Western, occurrence, geochemistry: Evans, T. L. 04222
Geochemistry
Biologic concentration: Boyle, R. W. 04234
Carbonate replacement deposits: Titley, Spencer R. 04155
Colloform texture, interpretation: Roedder, Edwin. 04230
Estuarine sediments and water, exchange capacity, technique: Duke, Thomas W. 04496
Mexico
Durango, Mapimi district, occurrence: Hoffmann, Victor J. 04131
Naica, Fresnillo, exploration: Villasenor, Luis. 04133
San Luis Potosi, ore guides: Gomez, Manuel. 04115
Mississippi Valley
Genesis, glaciation as cause: McGinnis, L. D. 04220
Geochemistry, trace elements: Hall, Wayne E. 04122
New Mexico
Hansonburg district, Mex-Tex deposits: Roedder, Edwin. 04223
Northwest Territories
Pine Point, genesis: Roedder, Edwin. 04231
Ore deposits, general
United States, central: Heyl, Allen V. 04238